PROCEEDINGS

OF THE

LIVERPOOL BIOLOGICAL SOCIETY.

VOL. I.

SESSION 1886—7.

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LIVERPOOL BIOLOGICAL SOCIETY.

SESSION 1886—7.

President:

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REPORT of the COUNCIL.

It seems desirable, by way of Introduction to the first Volume of the Proceedings of the Liverpool Biological Society, to give a short account of the origin of the Society and the object of its existence.

It had for long been felt by not a few local biologists that none of the existing scientific societies in Liverpool exactly covered the ground included under the word Biology as now understood. It was moreover manifestly impossible to alter any of these societies into one which would accurately supply this felt want without fundamentally changing the constitution and mode of procedure of the society so modified. To the majority of the members of those societies whose opinion was asked upon the matter, that alteration seemed undesirable. It was consequently proposed to found a new society devoted to the study of problems in biological science by the various methods now recognised as constituting the *modus operandi* of a scientific society.

With that end in view a meeting of biologists to whom the scheme commended itself was held in University College, Liverpool, on 11th December, 1886. Professor W. A. Herdman, D.Sc. who occupied the chair, briefly explained to the meeting the object for which it had been summoned. After some discussion it was unanimously resolved to found such a society as had been suggested, under the title of The Liverpool Biological Society. A code of laws, which had been prepared by a provisional committee, was thereupon read by the chairman and confirmed by the meeting, and the office bearers for the first session were elected.

The Society has held four Ordinary Meetings and one Field Meeting since its foundation, at each of which there has been an average attendance of over fifty Members.

At the conclusion of the last session there were ninety-three Ordinary and Student Members.

The following is a summary of the proceedings at the Ordinary Meetings:—

22nd January, 1887.

1. Inaugural Address, by Professor W. MITCHELL BANKS, M.D., F.R.C.S., President.
2. Recent Discoveries in connection with the Pineal and Pituitary Bodies of the Brain, by Professor W. A. HERDMAN, D.Sc., Vice-President.

12th February.

1. On the Mysidæ of Liverpool Bay, by A. O. WALKER, F.L.S.
2. On some Points in the Anatomy of *Alcyonidium gelatinosum*, by J. LOMAS, Assoc. N.S.S.
3. Remarks on the new translation of Sach's Text-book of Botany, by R. J. HARVEY GIBSON, M.A., Secretary.
4. On Boring Insect Larvæ, by J. W. ELLIS, L.R.C.P.
5. Exhibition and Description of Physiological Apparatus, by F. C. LARKIN, M.R.C.S.

12th March.

1. On some New and Little Known Copepoda of Liverpool Bay, by I. C. THOMPSON, F.R.M.S., Treasurer.
2. On the Classification of Anatomical Abnormalities, by A. WARD COLLINS, M.B., C.M.
3. Notes on Floral Morphology—No. I, by R. J. HARVEY GIBSON, M.A., Secretary.

23rd April.

1. On the so-called Hepatic Cells of the Earth-Worm (*Lumbricus terrestris*), by A. J. Chalmers and R. J. Harvey Gibson, M.A., Secretary.
2. Description of a New Tank for the Maceration of Osteological Preparations, by G. F. Moore.
3. On a Collection of Ascidians from Australian Seas, by Fanny D. Palethorpe and Charlotte Wilson.
4. Exhibition of Surface Animals from Maltese Seas, by David Bruce, M.B.
5. Exhibition of Wood bored by *Teredo*, from the Works of the Canadian Pacific Railway, by R. McMillan.
6. On the Discovery of Sponge Spicules in the Chert Beds of Flintshire, by G. H. Morton, F.G.S.

INAUGURAL ADDRESS.

By W. Mitchell Banks, M.D., F.R.C.S., President,
PROFESSOR OF ANATOMY IN UNIVERSITY COLLEGE, LIVERPOOL.

[Read 22nd January, 1887.]

To have been asked to become the first president of the Biological Society of Liverpool is an honour of which I am indeed proud. I wish I could say with equal sincerity that I feel myself worthy of the position. For years past the inroads upon my time made by the necessities of surgical practice and of hospital teaching have gradually driven me further and further back into my own corner of biology, viz. human anatomy, until now I find that it is as much as I can do to keep myself abreast of that department in the interests of my students. But I console myself by thinking that doubtless there are not a few in this assemblage, who find that all they can do is to cultivate some little patch in the biological garden, and that, after all, we may each of us contribute our modest flower to the common garland of knowledge.

The study of Biology by the public is but a thing of yesterday, but, at the same time, it has spread with the most amazing rapidity. And the desire for a more intimate and accurate acquaintance with it, which is now manifested by numbers who are not professional scientific investigators or teachers, has passed far beyond the stage of mere general interest, and can no longer be satisfied with the popular lecture of former days. In every great city there are numbers of men, who, for their own pleasure and recreation, have dug deeply into nooks and corners of the great mines of Natural History and Botany, and who can bring to the surface many a bit of rare and valuable ore. That is one reason why we have constituted the Liverpool Biological Society. Without such a society that bit of ore is too apt to be flung aside, after the first fleeting interest which it has excited has passed away. But when it is brought up before us here in the form of a paper or communication, it will have to be cleansed and sifted before it can be laid upon the table, and, when it has passed through the crucible of criticism and discussion, such good bright metal may be extracted from it as will be worthy to be added to the current coin of biological science.

Let every piece of work we bring here be turned over and over again. Let us have our doubts about it;—let us view our discoveries with suspicion, until we feel that we can satisfy, not ourselves only, but our fellows. Let us see that our building materials are sound. We can most of us only bring our brick, our beam of timber, our hod of mortar, but however small our contribution, let it be that of honest workmen. For some day there will come a master builder—a Darwin—who will gather these together, and will build a fair biological temple out of them, and it would indeed be a shame to us if our false work were to mar that edifice.

It is indeed a glorious thing to live in an age when the pursuit of knowledge for its own sake is admitted to be the noblest occupation of a man. The chemist of to-day is no longer the alchemist of yore, whose weary days and nights were consumed in the pursuit of that philosopher's stone, which was to make him the richest—and probably the wretchedest—of mankind. To-day, in science, we re-echo the old Welsh cry, "The truth before the world." What thought those chemists, who first in their laboratories distilled off ether and chloroform, and ticketed them with letters, and made notes on their atomic composition?

They never dreamed, that, within the last twenty-four hours, from Iceland to Cape Horn—from San Francisco to Bombay—these precious drugs have annihilated more human pain and anguish, than can have possibly been inflicted in the same time by all the warriors and tyrants on the face of the earth on all their battlefields, or scaffolds, or dungeons. As little did old Galvani reckon, as he watched the twitchings of his frogs' legs, that to-day his discovery would work such wonders, that the flying carpet, and Aladdin's lamp, and the Afrits and Genii of the Arabian Nights' Tales, would all be considered persons and things of an obsolete and somewhat antiquated character, about which there was nothing to astonish us.

We cannot quite find in Biology the astounding triumphs of physical science; but, as we grope about in our search after life and eternity, we may stumble over things that make even time and present existence happier and easier to bear. This very society owes its origin to the existence of the Liverpool Marine Biology Committee, a body of naturalists who associated together for the purpose of investigating the fauna of Liverpool Bay. They have made a series of valuable dredging cruises; valuable and, I am told, very pleasant withal. I do not doubt but that many a hardy weather-beaten fisherman, as he passed the tug where the dredging committee were bottling the crustaceans and annelids of their last haul, has pitied them, from the bottom of his soul, as individuals the harmlessness of whose amusement was the only saving clause which prevented them from being shut up in a lunatic asylum. He did not know that these gentlemen were really examining the soil of a farm;—that they were considering the adaptability of this bank for soles, and that bottom for oysters, of this ravine for bait, and of that rocky bed for lobsters, just as a farmer would lay out one field for wheat, another for grass, and another for potatoes. That fisherman did not know that we are learning how to sow fish as we do corn, and that we shall reap a crop in due time, if the fisherman will be good enough not to trample the rising braird under foot, nor tear up the potatoes of the sea when they are out in flower. To-day pisciculture is considered the fad of Professor Herdman and his dredging friends in the tugboat:—that fisherman's grandchild will probably be a fish farmer, and not a fish poacher like his grandfather. Gentlemen, this is a great and important economic subject, to which the labours of the practical fisherman have contributed nothing. It is a question which is being worked out by the biologist in his dredging expeditions and his laboratory observations, and by him alone. The fisherman has done his best to destroy his own farm, and in some instances has succeeded too well,—as every man who likes an oyster knows to his cost. We are told that the inhabitants of this island can no longer be maintained by the soil. Well, then they must be maintained by the sea, and if they cannot get corn and beef cheap enough, they ought to get fish. While Britannia rules the waves for her ships of commerce and war, she must also cultivate the bottom of the sea for her children's food. And that this Society will give good help in so great an object I do not for a moment doubt.

Any one who has studied carefully the progress of civilization must have been struck with what Buckle has made the key-note of his celebrated essay,—the fact that coincident with the progress of science in any country has been the progress of material prosperity and of freedom of thought. Music and sculpture and painting and polite literature, and even philosophy, may all flourish in an epoch when things are utterly false beneath the surface and rotten at the core, but the pale, clear flame of science can only burn in the pure atmosphere of truth and liberty. By no one, to my mind, has this been so forcibly and so convincingly pointed out as by Buckle. In his chapter on the French intellect, he draws a fine contrast between the great men who flourished in the early part of the 17th century, when Richelieu was curbing the church and defying the nobles, and the sycophantic writers of the next generation, who crawled about the throne of the Grand Monarque, when the protective spirit was again in the ascendant, and when the priests and the peers again had the power. And in speaking of one of the greatest of these great men, René Descartes, he says of him, "The same disregard of ancient notions, the same contempt for theological interests, the same indifference to tradition, the same determination to prefer the present to the past; in a word, the same essentially modern spirit is seen alike in the writings of Descartes and in the actions of Richelieu." He traces, moreover, to the sturdy scepticism of Englishmen the fact that in literature and in science we preceded by nearly a century our more acute and brilliant neighbours the French, whose credulity, and whose reverence for the past, was antagonistic to that spirit of enquiry, which is impossible when we believe that all that is or has been is right or settled. Science lives upon healthy unbelief, and is poisoned by dogma and tradition. In all our work, therefore, we shall do well to take nothing for granted that is not demonstrated beyond the possibility of a doubt.

When I spoke just now of scepticism, I used the word in its true sense, meaning thereby that reasonable doubt which induces a man to examine things for himself, in place of credulously accepting the dicta of those who arrogate to themselves the function of teachers. To the theological minds of former days all enquiry was more or less dangerous. Hence that perverted use of the word scepticism which has made it synonymous with irreligion. All thinking men must of necessity be sceptics, for doubt lies at the bottom of investigation.

It is hard for any young man of the present day to conceive of the amount of bigotry and intolerance that has been driven out of the human mind by the progress of science during the past seventy years. A short time ago I bought a copy of Lawrence's Lectures on Zoology. The book-stall keeper knew about his book, and put an extra value on it. Why? Because it was the edition which had to be called in, and which nearly ruined its author, by reason of its being considered such a wicked and blasphemous book. That was in 1822. I read it with some interest. To my present notion it appeared a very simple and elementary statement of some very commonplace things in Natural History that every sixth standard boy knows;—that young gentleman having apparently taken the place of Macaulay's fifth form school-boy, who has not been advancing lately. Poor Lawrence had hazarded a few speculations upon what life, and man, and mind might be;—and so the theologians, and even some of the ticketers and labellers of scientific goods, who passed muster as scientific men in those days, promptly set at him. Although, however, his lectures seem so crude and elementary now, they were prefaced by a defence of freedom of thought, which remains to this day a monument of his love of liberty and of his command of the English language. He says, "I plead not guilty, and enter on my defence with a confident reliance on the candour and impartiality of the tribunal before whom the cause is brought:—a tribunal too enlightened to confound the angry feelings and exaggerated expressions of controversy with the calm deductions of reason; and well able to appreciate this attempt at enlisting religion and morality on the side of self-love; by which difference of opinion—at all times but too irritating to the human mind—receives the double aggravation, of real inability to persuade and fancied right to condemn." When I remember that little more than thirty years ago I was taught to regard the "Vestiges of Creation" as a book fraught with the most pernicious doctrines, and dangerous in the extreme to my youthful mind, while the "Essays and Reviews" were such as could only be read with safety by men of mature years, who had clothed their intellects in the proof armour of sound theology, so that they could never be got at;—when I remember this, and consider what people say and think now, I can hardly believe that so short a time has effected so wondrous an advance in toleration of speech and freedom of thought. As Buckle eloquently says, "The only remedy for superstition is knowledge. Nothing else can wipe out that plague spot of the human mind. Without it the leper remains unwashed, and the slave unfreed."

This Society, although essentially a scientific one, hopes to interest and benefit the general public of Liverpool. It is meant to encourage those who have a natural taste for Biology to pursue it further than they would do, if left to their own unaided resources, unstimulated by the knowledge that many other people around them love the same things and would be glad to talk with them about such matters. And we, therefore, esteem it a great honour that our Mayor has set an example to his fellow citizens in joining us, and in lending us his hearty co-operation and assistance. But what gives us even greater pleasure, is that we all know that he in turn esteems it an honour to be Vice-President of the Biological Society. There is much, however, in a society such as ours, which can only be thoroughly done by men who make science the business of their lives. And we may, therefore, sincerely congratulate ourselves that we have as our moving spirit Professor Herdman, of University College, and as our secretary his able colleague, Mr. Harvey Gibson. We look to these gentlemen to regulate our meetings, to find out what each of us can do and make him do it, to draw up our transactions, to keep us in communication with other societies, to organize dredging cruises and field excursions, if these should come within our programme:—in short, we look to them to be our pilots. Through them, too, we hope to be kept in touch with the biological department of University College. That department, young as it is, hampered for want of proper laboratories, and with only the nucleus of a Natural History collection, can yet give us valuable help, while the relationship between the Society and the College will be a source of mutual aid and strength. And the events of the last few weeks have shown us, that we may hope with confidence some day to have a biological department worthy of the city and of the College. The noble things that have been done for the engineering department by Sir A. B. Walker and Mr. Thomas Harrison will produce imitators. There are plenty of good and generous men who will give their money, when they know that it is well deserved and well spent. It has been said that it is a difficult thing to give away ten thousand pounds, so as not to produce much heart-burning, or even to do positive harm. But whoever may find it in his heart to build a place, where the study of life and living things may be carried out, will be striking a rock from which shall flow a perennial spring, to slake the parched lips of those who thirst after learning, and to water the roots of the tree of knowledge.

Gentlemen, I thank you again very warmly for the honourable position in which you have placed me. I will do my best to fill it usefully for the society, for which I prognosticate a prosperous future. It will be one of those agencies, now springing up on every hand, which are fast making Liverpool not merely a centre of wealth and commerce, but also of art, and science, and literature. Long may they flourish together in our city.

RECENT DISCOVERIES in connection with the PINEAL and PITUITARY BODIES of the BRAIN.

By W. A. Herdman, D.Sc., F.L.S.,

PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

With Plates I. and II.

[Read 22nd January, 1887.]

[*Abstract.*]

The interest which has long centred around those two mysterious organs connected with the thalamencephalon of the vertebrate brain—the epiphysis cerebri dorsally and the hypophysis cerebri ventrally—has lately been intensified by the researches of De Graaf, Spencer, and others on the pineal gland of the Lacertilia and other lower Vertebrata, and of Julin and others on the subneural gland of the Tunicata. In both cases the recent investigations tend to show that these bodies, as we now find them in higher Vertebrata (Pl. I., fig. 1, *e* and *h*), are merely the useless rudiments of organs which were once of functional importance in lower forms.

I.—The Pineal Gland or Epiphysis Cerebri.

In a paper,* dated 19th January, 1886, and published on the 29th March of the same year, Von Henri W. de Graaf, of Leiden, gave a short account of the result of his investigations into the development of the epiphysis and of its structure in the adult of several species of Amphibia and Reptilia. He showed that this outgrowth from the

* Zur Anatomie und Entwicklung der Epiphyse bei Amphibien und Reptilien, Zoologischer Anzeiger, vol. ix., no. 219, p. 191.

dorsal surface of the brain developes into a vesicular distal and a stalk-like proximal portion, and that in some forms the distal part is converted into a remarkable structure resembling a sense-organ. This he found in its most developed condition in the Lacertilian *Anguis fragilis* where the parietal foramen in the roof of the skull is occupied by the rounded distal portion of the epiphysis in a form which he compares with a highly developed invertebrate eye, such as that of the higher Mollusca. De Graaf further suggests that in the lower vertebrates of former times, such as the Labyrinthodonts, the pineal eye may have played an important part as a sense-organ.

Shortly after the appearance of De Graaf's paper, W. Baldwin Spencer, now Professor of Biology at Melbourne, published a preliminary account* of his independent investigations into the structure of the pineal eye in some Lizards. This paper confirmed De Graaf's results, and treated specially of the condition of the epiphysis in *Hatteria punctata*, in which Spencer found the sense-organ in even a more highly developed and more interesting condition than in the case of the forms described by De Graaf.

A few months later, Spencer published a detailed memoir,† describing minutely the structure of the pineal sense-organ in a number of the Lacertilia, and comparing it with other sense-organs in Vertebrata and Invertebrata. In *Hatteria punctata* he found that the proximal portion of the epiphysis becomes converted into a nerve (Pl. I., fig. 3, *n.*), leading from the brain to the vesicular distal portion, which is modified into an eye-like structure lying imbedded in connective tissue in the parietal foramen.

* Nature, vol. xxxiv., p. 33, 13th May, 1886.

† "On the Presence and Structure of the Pineal Eye in Lacertilia," Quarterly Journal of Microscopical Science for October, 1886, p. 165.

The wall of the vesicle is cellular throughout, and its anterior or external portion is thickened to form a cellular lens (see Pl. I., fig. 3, *l.*), while its posterior or internal part is modified to form a retina (*r.*) composed of several layers of cells, of which those next to the cavity of the vesicle are rod-like and pigmented, while those lying outside are continuous with the fibres of the nerve going to the brain. Spencer concludes that this structure is an organ of sight, which, though probably not functional in any of the living forms in which it has been investigated, was an important median sense-organ in the extinct Vertebrata of Pre-Tertiary times.

Among the theoretical conclusions at which Spencer arrives from his investigations on the pineal eye there are two which seem to call for remark. The first is, that, although he points out De Graaf's mistake, in comparing the epiphysis with a molluscan eye such as that of the Cephalopoda, still in several passages he himself describes it as an invertebrate eye, or an optic organ of the invertebrate type. This I think is scarcely allowable, considering:—

1. That the epiphysis and its eye are an outgrowth from the nervous system, the cavity of the vesicle being the remains of a part of the cavity of the neural canal,

2. That the lens in the pineal eye is cellular, being formed from the descendants of some of the epiblast cells of the wall of the neural canal,

3. That the retina is likewise derived from epiblast cells of the wall of the neural canal.

In fact the only point in which the pineal eye resembles the invertebrate type is in having the epithelial layer of the retina directed towards the source of light and the nervous layer towards the nerve supply.

The three diagrams (figs. 2 to 4) on Pl. I. represent:—

(fig. 2) the vertebrate paired eye, (fig. 3) the vertebrate pineal eye, and (fig. 4) a well developed invertebrate eye, and show that such important differences exist between them all that the pineal eye cannot be considered as resembling either the paired vertebrate eyes or the ordinary higher invertebrate eyes, but must be regarded as a type distinct from both.

It may be pointed out, as an instance of the important differences between the three eyes, that the large central cavity between the lens and the retina (see Pl. I., figs. 2, 3, 4) is of an entirely different nature and origin in each. In the pineal eye (fig. 3, *C(n).*) it is a part of the original cavity of the neural canal, and is surrounded by epiblast. In the paired vertebrate eye (fig. 2, *C(v).*) the central cavity (occupied by the vitreous humour) is formed in the mesoblast, and has nothing to do with the neural canal; while in the invertebrate eye (fig. 4, *C(e).*) the cavity is outside the epiblast and is bounded in front by the thickened cuticle.

The second point is, that Spencer comes to the conclusion (see *l.c.*, p. 232) that "The epiphysis of higher Chordata is the homologue of the larval Tunicate eye." This homology I am greatly inclined to doubt, and although it may not be possible at present to disprove it, still I think that the evidence in favour of it is insufficient, and that therefore it cannot be accepted.

It may be pointed out (1) that the lens in the eye of the larval Tunicate is not cellular, and (2) that if the Tunicate eye was pushed out to form a vesicle the retina would be found in the position occupied by the lens in the pineal eye (see Pl. I., fig. 5). Spencer recognized both these difficulties, but apparently did not consider them of sufficient importance to destroy the homology.

I am at present inclined to regard the sense-organs of the larval Tunicata as having been probably evolved independently in that group, and as having no phylogenetic relations with the corresponding organs of any other group.

II.—The Pituitary Body or Hypophysis Cerebri.

In 1867 Hancock* discovered in the Tunicata a glandular body lying below the single nerve ganglion. In 1876 Ussow† investigated the structure of this body more minutely, and traced a delicate duct leading from its anterior end to open into the front of the branchial sac. Julin, in a very important paper,‡ published in 1881, gave the results of his examination of this subneural gland and its duct in a number of Simple Ascidians, and showed that the so-called dorsal or olfactory tubercle placed upon the anterior dorsal part of the branchial sac contains the complicated opening of the duct from the gland (Pl. II., fig. 1, *d.t.*)

Julin comes to the conclusion that the subneural gland in the Tunicata is the representative of the hypophysis cerebri of the vertebrate brain (Pl. I., fig. 1, *h.*), and bases this homology upon, (1) its glandular structure, (2) its position on the ventral surface of the ganglion (brain), and (3) its connection with the anterior end of the branchial sac (pharynx). It is suggested, both in a second paper published in the same year, and also in subsequent memoirs by E. van Beneden and Julin, that the hypophysis cerebri functioned originally as a renal organ, and

* Jour. Linn. Soc., Zool., vol. ix.,

† Contributions to our Knowledge of the Organisation of the Tunicata (in Russian.) Imper. Soc. of Nat. Sc., Moscow, vol. xviii.

‡ Recherches sur l'organisation des Ascidies Simples—Sur l'Hypophyse, &c. Arch. de Biol., vol. ii., p. 59.

that the subneural gland in the Tunicata now performs the same function.

From the time of Savigny (1816) up to Julin's investigations the dorsal tubercle in Ascidians had been regarded as a sense-organ, for the purpose of testing the quality of the water entering the branchial sac (Pl. II., fig. 2). Julin, however, insisted upon its non-nervous nature, and regarded it as being merely the opening of the duct from the hypophysis into the front of the pharynx.

In a short paper, published in July, 1883,* I, arguing mainly from the very complicated condition of the dorsal tubercle in many Ascidians, suggested that possibly this organ may be both the aperture of the hypophysial gland and also a sense-organ of a gustatory or olfactory nature. I pointed out that if the hypophysis cerebri was, as E. van Beneden and Julin think, a renal organ in the anterior part of the body of the primitive Chordata, its ducts—supposing it to be formed of several pairs of nephridia—would originally open on the sides of the body (Pl. II., fig. 3, left side), and might have then become implicated in the sinking in of the epiblast to form the atrial involutions (Pl. II., fig. 3, right side), and so would come to open into the peribranchial cavity (a condition found in some Ascidians). The dorsal tubercle again may have been a sense-organ in the same primitive Chordata, placed at or near the dorsal edge of the mouth opening, which afterwards changed its position, perhaps along with the involution of the epiblast which forms the branchial siphon (stomodæum), so as to reach the dorsal edge of the buccal cavity (Pl. II., fig. 4, *h*). I would regard then the connection between the duct, or one of the ducts, of the subneural gland and the dorsal tubercle as being secondary.

* Nature, vol. xxviii., p. 284.

Roule, in 1884, in an elaborate work on the Simple Ascidians of the coasts of Provence,* discusses the above theories, and comes to the conclusion that the dorsal tubercle is not a sense-organ, and that the hypophysial gland is not a renal organ, but merely a gland for the production of the mucus which is spread over the front of the branchial sac to entangle food particles contained in the passing water.

This theory is open to the objection that it does not account for the varied and highly complicated condition of the dorsal tubercle in most Ascidians. On the other hand, the absense of a direct and conspicuous nerve supply tells against the view that the tubercle is at the present time a functional sense-organ. Possibly that was its original function, but was lost after the connection with the duct from the gland became established, and, as a result, the nervous connection with the ganglion has since disappeared. Further investigations, however, are required to clear up this matter. Embryology as yet has thrown no light upon the subject.

Recent investigations, then, tend to establish that the pineal gland and the pituitary body of the vertebrate brain are both of them the remains of organs which reached the surface of the head in the ancestral Chordata (see hypothetical form represented on Pl. II., fig. 4)—the pineal in the form of a median dorsal organ of sight, and the pituitary possibly also as a sense-organ placed on the front of the head close to the mouth opening.

* Ann. du Musée de Marseille, Zool., t. ii., Mém. no. 1.

Explanation of the Plates.

Note.—Figures 3 and 4 in Plate II. are intended only as diagrams to aid the reader in following the speculations in regard to the subneural gland and dorsal tubercle given in the text, and must not be considered as representing in detail the author's views in regard to the probable condition of the hypothetical ancestral Chordata.

Lettering.—*e.*, pineal gland; *h.*, pituitary body; *r.*, retina; *l.*, lens; *n.*, nerve; *C(n).*, *C(v).*, *C(e).*, central cavity in pineal, vertebrate and invertebrate eye; *d.t.*, dorsal tubercle; *d.*, duct; *s.g.*, subneural gland; *g.*, nerve ganglion; *ch.*, notochord; *n.c.*, neural canal; *st.*, stomodæum; *pr.*, proctodæum; *neph.*, nephridia; *a.n.*, anterior nephridium; *t.*, Thalamencephalon.

Plate I.

Fig. 1. Diagrammatic vertical longitudinal median section of the vertebrate brain, showing the relations of the Pineal gland (*e.*) and Pituitary body (*h.*) to the Thalamencephalon (*t.*) (partly after Huxley, partly after Wiedersheim).

Fig. 2. Diagrammatic section of the vertebrate paired eye.

Fig. 3. Diagrammatic section of the pineal eye of *Hatteria* (after Spencer).

Fig. 4. Diagrammatic section of an invertebrate eye.

Fig. 5. Diagram of the eye of a larval Tunicate (after Kupffer).

Plate II.

Fig. 1. Diagram showing the relations of the dorsal tubercle (*d.t.*), subneural gland (*s.g.*), and ganglion (*g.*), in an Ascidian.

Fig. 2. The dorsal tubercle, &c. of *Ascidia mentula* from the ventral surface (after Julin).

Fig. 3. Diagrammatic representation of the anterior end of hypothetical Proto-Chordate, showing renal organs (nephridia) opening on the left side on the surface of the body, and on the right into the peribranchial involution.

Fig. 4. Diagrammatic representation of hypothetical Proto-Chordate from the left side.

NOTES on the MYSIDÆ of LIVERPOOL BAY.

By A. O. Walker, F.L.S.

[Read 12th February, 1887.]

In Bell's "History of British Stalk-eyed Crustacea," only one genus (*Mysis*)—*Thysanopoda* being now placed in a separate family—with three species is recorded, as belonging to the family Mysidæ. The number has since been greatly increased, the genera now being *Erythrops*, *Mysidopsis*, *Leptomysis*, *Mysis*, and *Siriella*, containing at least thirteen species in addition to those described by Bell. Most of these are enumerated by the Rev. Canon A. M. Norman, in the Ann. and Mag. of Nat. Hist. for 1887.

The British species of the genus *Mysis*, so far as known to me, are :—

a. *Mysis flexuosa*, Müller=*M. chamæleon*, Thompson.

b. *M. inermis*, Rathke . . .	Apex of telson bifurcate.
c. *M. arenosa*, Sars	
d. *M. spiritus*, Norman . .	
e. *M. lamornæ*, Couch . . .	
f. *M. productus*, Couch . .	Apex of telson entire.
g. *M. vulgaris*, Thompson.	
h. *M. oberon*, Couch	
i. *M. griffithsiæ*, Bell . . .	

a. Bell—Hist. British Stalk-eyed Crustacea, p. 336. Norman—Ann. and Mag. Nat. Hist., vol. vi. (3rd Series), p. 429.

b. Norman—Rep. Brit. Association, 1868, p. 266.

c. Sars—Nye Bidrag till Kundsgaben Middelhavets Invertebratfauna, &c.

Of the above species only two were recorded in last year's Report of the Liverpool Marine Biology Committee, viz. *M. flexuosa* and *M. spiritus*, both of which are tolerably common on the North Wales coast. To these must now be added *M. vulgaris*, taken last summer by Mr. F. Archer,

Fig 1.

Fig 2.

at the mouth of the Alt. Mr. Archer kindly sent me twelve specimens, of which nine were males and three females. They proved to be remarkable, from the fact that four of the males and two of the females had the tail-

d. Norman—Ann. and Mag. N. Hist., 3rd Series, vol. vi., p. 431.

e. do. do. do. p. 430, Zoologist, 1856.

f. Couch—Ann. and Mag. N. Hist., 2nd Series, vol. xii., p. 156, pl. 6.

g. Thompson—Zool. Researches. Bell—Brit. Stalk-eyed Crustacea.

h. Couch—Zoologist, vol. xiv., 1856, pp. 5284-88.

i. Bell—1. c.

See also Sars, Monograph of the Norwegian Mysidæ, for figures and description of most of the above species.

piece or telson (*i.e.* the modified terminal segment of the pleon or abdomen) abnormal.

The normal telson tapers gradually with almost straight sides to a narrow apex, which terminates in two strong and rather long spines, having two very small spines between them (fig. 1). In one of the males the abnormality consists only in having three instead of two small spines between them, but in the other three abnormal males and in the two females the spines at the apex are much more numerous, and are irregular in size and direction, and in one of the females the telson itself is markedly unsymmetrical, as shown by the drawing (fig. 2).

Mr. Archer informs me that there is much sewage in the Alt, which may perhaps be the cause of the abnormality in question. Had only one of the abnormal specimens been taken without any of the normal form, it is easily conceivable that a new species might have been founded on it; the moral of which is that when one has a chance of securing a number of specimens one should always do so.

Note.—Since the above was written I have taken *Mysis lamornæ* (Couch), at Colwyn Bay, in three fathoms, on the 24th May, 1887. It was taken with other Crustacea in a dredge lined with canvas, and having the lips protected by round sticks fastened on them so as to prevent them from digging into the sand.

NOTES on the Structure of ALCYONIDIUM GELATINOSUM.

By Joseph Lomas, Assoc. N.S.S.,
SPECIAL LECTURER ON GEOLOGY IN UNIVERSITY COLLEGE, LIVERPOOL.

With Plate III.

[Read 12th February, 1887.]

This species of Polyzoon, so common in the rock pools round our shores, has attracted much attention from naturalists.

Sowerby, in his "English Botany," and Lamarck and De Candolle, in their "Flore Française," ii., p. 6, believing it to be a plant, describe it under the name of *Ulva diaphana*.

John Ellis, F.R.S., in his "Essay towards a Natural History of the Corallines," (1755), plate xxxii., figs. D. d., p. 87, calls it *Alcyonium seu Fucus nodosus et spongiosus*. He made transverse sections, and after remarking that the species needs more critical enquiry, suggests that it may be the spawn of some shell fish.

In the works of Linnæus, Pallas, Ellis and Solander, Lamouroux, &c. it goes by the name of *Alcyonium gelatinosum;* and was first placed in the Polyzoa by Lamouroux. Van Beneden calls it *Halodactylus diaphanus*, in his "Recherches sur les Bryozoaires," p. 59; and under the same name, Dr. Farre (Phil. Trans., 1837) gives a most valuable and interesting account of the species.

The name has now been changed to *Alcyonidium gelatinosum*, and is so described in all recent works on the subject.

The colonies are found adhering to rocks, stones and dead shells, and range bathymetrically from tide mark to 40 or 50 fathoms. The young colony is of an elongated pear shape, being attached at the narrow end (Pl. III., fig. 1). The adult assumes countless forms, but is in the main cylindrical, sometimes compressed laterally, branches being given off which are also cylindrical and very irregularly placed, but mostly at right angles to the main axis.

Under the microscope the surface is seen to be raised into a great number of blunt papillæ, which are closely packed, but in no definite order.

On making a transverse section, the true relations of the polypides are seen. The cells are arranged radially, the mouth opening on the exterior. They are embedded in a gelatinous mass, and the core of the cylinder consists of a mass of cells of a gelatinous nature, containing a liquid.

The gelatinous portion is probably comparable to the calcareous parts of some of the other Polyzoa, and the general appearance is strongly suggestive of *Salicornaria*, which is also cylindrical and has its polypides radially arranged, but with the cells embedded in a calcareous covering.

In some specimens of *Alcyonidium gelatinosum*, in fact in all those I have examined in the fresh state from the Liverpool Marine Biology Committee's district, spicules are found embedded in the gelatinous part of the colony, mostly in the peripheral regions.

A description of these spicules may be found in the Proceedings of the Liverpool Geological Society, vol. v., part ii. They are small in size, the largest not being more than ·14 to ·2 mm. in length, and in width they are about ·05 mm. In shape they are rudely cylindrical and slightly curved, some being a simple half-moon and others S shaped (Pl. III. fig. 2).

Mr. A. Norman Tate, F.I.C., has kindly examined some spicules for me, with the view of arriving at their chemical composition, and finds them to consist of the carbonates of lime and magnesia, largely intermixed with organic matter.

The spicules could not be the result of post-mortem changes, for they can easily be seen in the living animal. As to their origin and significance, three theories suggest themselves.

They may be accidental, *i.e.* foreign matters enclosed by the animal. Secondly, they may be developed in the ectocyst, to bind together and give rigidity to the gelatinous mass; or, thirdly, they may be vestiges of calcareous ectocysts owned by the ancestors of *Alcyonidium.*

Against the first theory, it may be urged that they are more regular in shape than would be otherwise expected. Again, they are calcareous, and the organism would probably have taken in grains of sand, which are frequently found in the alimentary canal. The forms yielding the spicules are from localities far apart, and yet the spicules are practically indistinguishable, and there are no organisms living on our shores which contain anything likely to be the producers of the spicules.

The second theory is more plausible, and there are usually numerous active ectoderm cells surrounding the spicules.

But the third theory seems the most probable, and regarding these spicules as vestiges of ancestral structure, it would indicate that the Ctenostomatous forms are derived from others which possessed a calcareous ectocyst.

Turning now to the individual polypide, we find it is enclosed in a bag or ectocyst. In transverse section the ectoderm can be seen extending as a thin, apparently structureless layer from the exterior round the cell. Lining this is a clear layer of mesoderm, to which the muscular bands and the funiculus are attached. Round the mouth is a circlet of short blunt setæ, which form the ctenostome. They close the aperture when the polypide is retracted. Smitt gives the number of setæ as 14—15, but in some specimens I have counted more than twenty.

Round the mouth in the inner side is a mass of cells, from which springs the tentacular sheath. This consists of muscular fibres arranged longitudinally and transversely. A very powerful sphincter muscle contracts the neck when the polypide is not expanded. Strong retractor muscles spring from the sheath where it joins the lophophore and run to the cell walls (parieto-vaginal muscles). (Pl. III., fig. 3.)

Looking down on the invaginated tentacular sheath, one sees a circular aperture, and the walls open out in a cone-like manner, the lower end being continuous with the lophophore. (Pl. III., figs. 3 and 4.)

Round the mouth, on the outer surface, is found in most specimens a cluster of long hair-like bodies, some resting on small raised papillæ. Their function would seem to be sensory, and they probably indicate the approach of danger or the proximity of food. In the living state they move about slowly when the polypide is retracted (Pl. III., fig. 3).

The lophophore bears 15—17 tentacles, according to Hincks. In all those examined by myself the number has been sixteen. They are longer in one direction than the other, as pointed out by Dr. Farre (Phil. Trans., 1837).

These notes only treat of a few points of structure, and many other details in this species require investigation. The embryology especially calls for further research, but as this can only be satisfactorily done with the animal in the living state, it is hoped that the Marine Biological Station at Puffin Island may afford opportunities of investigating the matter.

Explanation of Plate III.

Fig. 1. Young *Alcyonidium gelatinosum* on shell, showing elongated pear shape.

Fig. 2. Calcareous spicules found in peripheral parts.

Fig. 3. Longitudinal section of a cell as seen in a transverse section of *A. gelatinosum.*

a, Ctenostome; *b*, tentacular sheath; *c*, tentacles; *d*, lophophore; *e*, cells surrounding the mouth end of the tentacular sheath; *f*, funiculus; *g*, stomach; *h*, hairs surrounding mouth, some on short papillæ; *i*, intestine; *k*, anal opening; *mf*, muscular fibres.

N.B.—Only such parts are shown as have a bearing on the paper.

Fig. 4. The tentacular sheath as seen from below:—*b* and *mf*, as in fig. 3.

On some COPEPODA, new to BRITAIN, found in LIVERPOOL BAY.

By Isaac C. Thompson, F.L.S., F.R.M.S.

With Plates IV., V. and VI.

[Read 12th March, 1887.]

Since the first Report on the Marine Fauna of this district was issued, nearly two years ago, a considerable number of additions have been made to the Copepoda then recorded, and amongst them a few species new to British seas.

As previously, the tow-net has been continuously used at the various marine excursions of the L. M. B. C., and it is somewhat remarkable, that whereas in the summer of 1885 all tow-netting operations were seriously impeded by the widespread diffusion of a minute gelatinous spherical Alga, no trace of it was discovered during the summer of 1886.

As remarked in the Report,* this Alga was found to be inimical to animal life, besides choking the fine pores of the tow-net; hence probably the better results obtained in 1886.†

One of the commonest and most widely distributed of the British Copepoda is *Temora longicornis*. This we had taken in almost every gathering about the district,

* Liverpool Marine Biol. Rep. I., p. 201.

† Since the above was written, when tow-netting in March, 1887, up the Menai Straits, from Bangor to Puffin Island, another species of Diatomaceous Alga was found in profusion, and is since that date very abundant about our estuary, with the result of again greatly limiting the amount of Copepoda taken in the tow-nets.

and it was the only species of the genus we had recorded. But in April, 1886, two bottles were sent to me by Mr. Clubb, containing the surface gatherings of two night and early morning tow-nettings, obtained from a fishing boat in the Crosby Channel, and between Formby and Southport. *Temora longicornis* was present in large quantities, and with it a number of another species not previously observed here. Upon looking up the literature of the subject, this species was found to be *Eurytemora hirundo* of Giesbrecht, described and figured by him in "Die freilebenden Copepoden der Kieler Foehrde," and found by him only in the Ostsee (Baltic). It occurs in the material collected by Mr. Clubb on two separate days, the 9th and 23rd of April, both from the Crosby Channel, at night, but we have not taken it before or since, or in any other locality, nor has it been elsewhere recorded by any one except Giesbrecht.

Giesbrecht proposes to divide the genus *Temora* of Baird into two sub-genera, *Halitemora* and *Eurytemora*, as follows, the characters of the two divisions being sufficiently distinct to warrant it.

TEMORA.

Halitemora				*Eurytemora*			
,,	*longicornis,*	Müller,	1785.	,,	*inermis,*	Boeck,	1864.
,,	*velox,*	Lilljeborg,	1853.	,,	*clausii,*	Hoeck,	1876.
,,	*dubia,*	Lubbock,	1856.	,,	*affinis,*	Poppe,	1880.
,,	*armata,*	Claus,	1863.	,,	*hirundo,*	Giesbrecht,	1881.

The *Halitemora longicornis* and *H. velox* are the only hitherto known British species of *Temora*, to which is now added *Eurytemora hirundo* (Pl. IV., fig. 1).

Males and females were found in about equal quantities; the right antenna of the male (fig. 2), and the difference in the first pair of swimming feet, as shown in figs. 3 and 4 in the two sexes, being very distinctive. Most of the females had mostly spermatophores attached to the vulvar region of the abdomen; in some cases as many as six were attached to one animal, resembling somewhat a bunch of tallow candles; some had ovisacs in addition.

A marked feature about the females of *Eurytemora*, in common with those of some other genera of Copepoda, is the presence of a leaf-like projection on either side of the animal at the termination of the cephalothorax (fig. 1). These appendages appear to act as protective coverings for the ova and spermatophores, which might, and probably would, be dangerously exposed as the animal rapidly swims through the water. They appear to serve the same function as the strong cephalothoracic spines, so conspicuous in *Centropages* and other Copepoda. In most other respects the *Eurytemora hirundo* has the characteristics of the genus *Temora*, as clearly figured and described by Brady in the species *longicornis*.

Another interesting addition to the British fauna is *Dias discaudatus*, several of which were taken off the Anglesey coast, during the cruise of the "Hyæna," in May, 1886. Like the last, this species was first described and named by Giesbrecht, being found in one locality of the Baltic. In general appearance it much resembles *Dias longiremis*, a very common British species, and from this cause it seems to me exceedingly probable that its separate identity may thus have been overlooked, and that it may be much more widespread than is supposed. As *Dias longiremis* is well figured by Brady and others, I need only refer to these authors for the several characters of the genus, and direct attention to the special structural differences of *D. discaudatus*. First of these is the elegantly plumose character of the anterior antennæ (Pl. V., fig. 1) and caudal setæ (figs. 2 and 3). Another noticeable feature is in the caudal terminations (figs. 1 and 2), which in *D. longiremis* are somewhat long and angular, but in *D. discaudatus* are short and rounded. This is, perhaps, the most readily recognizable difference between the two species. In both, the terminal spines of the swimming feet (fig. 4) are long, slender and sword shaped, and finely serrated on the inner border. The swimming feet, including the fifth pair, are of the same general shape and character in both species, but here again the spines are plumose in *D. discaudatus* and plain in *D. longiremis.* This is specially noticeable in the female (fig. 5).

The remaining species to be here noted is *Pontella wollastoni,* Lubbock. This was first described by Sir John Lubbock in 1857, and probably agrees with the *P. heligolandica* of Claus, described in his "Die freilebenden Copepoden," in 1863. It appears not to have been taken in England during the past thirty years, and it was therefore with a thrill of pleasure that I welcomed a considerable number of this large and peculiarly striking Copepod in the gatherings taken by the tow-net in the "Weathercock" expedition of 28th August, 1886, about half way between Liverpool and Isle of Man.

The general appearance of the animal is shown in Pl. VI., fig. 1. It is one of the very largest of the British Copepoda, and, like the somewhat allied species *Anomalocera patersonii,* is conspicuous by a strong curved hooked spine on each side of the anterior portion of the cephalothorax. These are not illustrated by Brady in his drawings of either species, but his drawing of *Pontella heligolandica* was, as he says, taken from a mutilated specimen preserved in spirit.

The leaf-like appendages to the basal segments of the cephalothorax, as noticed in *Eurytemora hirundo,* are present also in the females of this species, and are no doubt of great protective service. The right anterior antenna of the male is shown in Pl. VI., fig. 2, with its strongly beaked rostrum at the base. The strong hooked spines in this antenna and the deep saw-like serratures on the seventeenth and eighteenth joints are very diagnostic.

The termination of one of the swimming feet, with its finely serrated edge, is shown on fig. 3, and the fifth pair of feet of male and female on figs. 4 and 5. It will be seen that the right foot of the male's fifth pair is provided with a large moveable spinous claw, and is well adapted, in conjunction with the powerful right antenna, for clasping the female during copulation. The fifth feet of the female are each provided with a pair of pointed claw-like spines (fig. 5), and are unlike those of any other Copepod with which I am acquainted.

The presence and distribution of Copepoda in our seas are most vitally interesting, forming, as they unquestionably do, by far the largest proportion of the life of the ocean. And being themselves of the utmost purifying utility as scavengers, they transform the refuse, by their internal biological and chemical laboratories, into food for higher orders of ocean denizens—these again furnishing, in illimitable quantity, the food of man.

Explanation of Plates.

Plate IV.

Fig. 1. *Eurytemora hirundo* (Giesbrecht), entire animal, female.

Fig. 2. Do. do. right antenna, male.

Fig. 3. Do. do. right and left foot, male.

Fig. 4. Do. do. fifth foot of female.

Plate V.

Fig. 1. *Dias discaudatus* (Giesbrecht), anterior antenna, male.
Fig. 2. Do. do. caudal termination, female.
Fig. 3. Do. do. caudal termination, male.
Fig. 4. Do. do. terminal spine of one of swimming feet.
Fig. 5. Do. do. fifth foot of male.
Fig. 6. Do. do. fifth foot of female.

Plate VI.

Fig. 1. *Pontella wollastonii* (Lubbock), entire animal, female.
Fig. 2. Do. do. anterior antenna, male.
Fig. 3. Do. do. termination of one of swimming feet.
Fig. 4. Do. do. right and left fifth foot of male.
Fig. 5. Do. do. right and left fifth foot of female.

The Classification of ANATOMICAL ABNORMALITIES.

By A. Ward Collins, M.B.,
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[Read 12th March, 1887.]

It is impossible, in a short paper, to consider at all fully all the varieties of human anatomical abnormalities, and therefore I only intend to give a concise classification of them, and to illustrate the different classes by a few examples taken from cases or specimens which have come under my own observation.

An abnormality may be defined as any deviation from the normal, or average, structure of a part.

Abnormalities vary, as to their frequency (in fact some minor abnormalities are so often present, that it is sometimes doubtful what should be considered as being normal,) and as to the extent of their departure from the usual formation; but whatever the nature or degree of an abnormality, it may be included in one or more of the following five classes :—

1. Apparently purposeless abnormalities.
2. Pathological abnormalities.
3. Compensatory abnormalities.
4. Abnormalities due to persistence of embryonic form.
5. Reversive abnormalities.

The large class of apparently purposeless abnormalities includes all those for whose existence no reasonable explanation can be found. Such are the cases of high division of the great sciatic nerve, or the case (which I have already published) in which the radial artery was twisted upon itself, so as to form a complete circle round the profunda vein. To this class also belongs an extremely interesting specimen, found in our dissecting room this winter, in which the large intestine, when it reached the front of the left kidney, inclined to the right across the lower end of the abdominal aorta, and after forming the sigmoid flexure in the right iliac fossa, descended into the pelvis as a right-sided rectum. These and many others appear at present to be pure freaks of nature; but I am glad to think that, with increasing knowledge, the number of abnormalities, thus vaguely classified, will be lessened, until we may, perhaps, be ultimately able to include them all among the other more definite classes.

As to pathological abnormalities—*i. e.* those depending upon disease or injury—although often medically or surgically important, they possess no biological or general interest, and I have only mentioned them to make my classification complete.

The third class—compensatory abnormalities—is composed of anatomical examples of a natural law, frequently shown in other forms of organic and functional life.

In anatomy, if any part is not supplied with blood from the usual source, it derives it from another, or, if a muscle is deficient, its place is sometimes supplied by the abnormal formation of another one.

For example, if the obturator artery is too small or impervious, it is supplemented or replaced by the enlargement of a normal anastomosing branch from the deep epigastric, and this, which is described as an abnormal origin of the obturator, is of some surgical importance, as in a certain operation it is liable to be wounded, and give rise to dangerous, or even fatal, hæmorrhage.

I have met with one case, in which the flexor profundus digitorum gave no tendon to the little finger, and its place was supplied by the flexor sublimis, furnishing both the superficial and deep tendons to that finger.

The abnormalities due to persistence of embryonic form depend upon defective development—that is to say, the part affected reaches a certain stage of development, but then, instead of advancing *pari passu* with the rest of the body, remains in a condition which, though normal to the embryo, is abnormal to the properly developed subject. In this class I include, not only the abnormalities consisting of the persistent embryonic form *per se*, but also those to which such persistence gives rise—as meningocele, spina bifida, ectopia cordis, and others.

Everyone is familiar with the difference between sheep kidneys and what I believe, in domestic parlance, are usually called beef kidneys—the former have smooth, even surfaces, while the latter are composed of a number of partially united lobules. Well, all kidneys (above a certain class), in their early embryonic condition, are formed of separate lobules, and it is only as development proceeds that these coalesce; and I have found an adult human kidney retaining this rudimentary form, the constituent lobules being very imperfectly united.

In the embryo, the blood coming from the inferior vena cava is directed by the eustachian valve across the right auricle, and passes into the left auricle through an opening, the foramen ovale, in the inter-auricular septum. Usually this opening becomes occluded a few days after birth; but in specimen of which I obtained this session, this had not taken place, and the foramen remained large enough to admit the tip of the little finger.

The two specimens exhibited, which are from our anatomical museum, show a persistence of two superior venæ cavæ or precaval veins. These two large veins are joined together superiorly by a transverse connecting branch; as development proceeds this branch should enlarge and become the left innominate vein, and the left precaval should atrophy to a fibrous cord. This has not occurred, and so the parts remain in their embryonic form—a form, moreover, which is normally persistent in many lower animals, prevailing largely in the Lizards, and also being constant in many of the Mammalia. In the Monotremes there are not only two precavals, but also a well marked connecting branch, which I have already referred to as becoming, in man, the left innominate vein.

Examples of the fifth, and last, class of abnormalities—reversive—are frequently found. This large class includes everything which, being an abnormality in human anatomy, is normally present in one or other of the lower animals.

In one subject I found that the pectoralis minor, instead of being inserted into the coracoid process, passed over it, to blend with the capsular ligament, and be attached above the glenoid fossa of the scapula: in the dog this muscle is normally thus inserted.

The humerus has occasionally a supra-condylar process. This not very infrequent abnormality—of which I have found one or two other specimens—is the representative, in man, of the supra-condylar foramen found in many of the Carnivora, especially the Felidæ, in most of the Insectivora, in the common seal, and in all the Edentates except *Bradypus*.

In our dissecting room this winter we have met with two examples of the sternalis muscle, which exists in many of the lower mammalia.

It is not unusual to find one or more slips connecting the flexor sublimis with the flexor profundus digitorum. In most of the lower mammals these muscles are blended, but as the scale is ascended the two muscles become more and more distinct, until in monkeys they are usually separate (the Aye-Aye, however, having a connecting slip), and in man any connection is abnormal.

The biceps flexor cubiti, as its name implies, has usually only two heads of origin, but occasionally a third head is found. I have met with several examples of this, and in one of them the third head arose from the lower end of the pectoral ridge of the humerus. This third head, arising from this position, is constant in one of the Anthropoid Apes, the Gibbon.

It may be noticed that one or two of the abnormalities, which I have placed in the compensatory and embryonic classes, might also be included amongst the reversive. More particularly with reference to the embryonic class this is easily understood, as during development the human embryo passes through stages closely resembling, in many details, the adult condition of the lower mammals. So much is this the case, that it is as easy to conceive that one of these same lower animals should in time reach a state of evolution as high as our own, as that this embryo should develop into a man—instinct with life and reason.

In one subject no less than seven examples of muscles peculiar to apes have been found (J. Wood), but in addition to these occasional similarities, we must remember that so closely does our normal muscular system resemble that of monkeys, that until the fifteenth century all knowledge of human myology was derived from the dissection of these animals.

What importance are we to attach to reversive abnormalities? Are we to consider them as merely chance developments, due, as it were, to accidental variations in the mould; or are we to regard them as possessing a further signification, and meriting the title "reversive?"

If the latter, then we must look upon them as showing a tendency towards a more primitive type, being, as it were, an occasional reproduction of some ancestral feature. Believing this to be so, we are fully justified in regarding them as indications of descent from the lower animals; and we may consider every reversive abnormality as but an additional weight in the scale in favour of the great theory of evolution.

NOTES on FLORAL MORPHOLOGY.

By R. J. Harvey Gibson, M.A., F.R.S.E.,
LECTURER ON BOTANY IN UNIVERSITY COLLEGE, LIVERPOOL.

[Read 12th March, 1887.]

No. 1.—On the comparative value of the polypetalous and gamopetalous corolla as an organ of protection to the anthers from wind.

The law of cross-fertilization amongst plants and animals is now generally admitted by biologists to be one of extreme importance, and of far-reaching application. Briefly stated, that law affirms that cross-fertilization produces the greatest number of seeds capable of germination, while self-fertilization tends to produce few or no seeds capable of germinating; and, further, that seeds which are the result of cross-fertilization always tend to survive those which are the result of self-fertilization.

Since plants are as a rule stationary, it follows that agencies are needed for the transport of pollen from one plant to another. These agencies are, generally speaking, two—wind and insects. Plants which are cross-fertilized by the agency of wind are termed anemophilous; those which are cross-fertilized by the help of insects, entomophilous.

In the present paper we are concerned only with the entomophilous forms, save where it is necessary to contrast these with anemophilous examples. The chief points of distinction between these two varieties are (for our purpose), (1) that in the anemophilous flower the essential organs, the andrœcium and gynœcium, are exposed, and the perianth is insignificant, whilst in the entomophilous flowers they are protected, and the perianth is well developed; and (2) that in the anemophilous flowers a large quantity of pollen is produced, with, therefore, a large margin for waste, whilst in the entomophilous forms the pollen is much less in amount, with little margin for waste.

From the fact that there is a small margin for waste in the amount of pollen produced by entomophilous flowers, it follows necessarily that the pollen must be protected from winds. It is, in some cases, so protected by the nature of the pollen itself, which tends towards viscidity, as opposed to the dry dusty pollen of the anemophilous flower. At the same time there can be no doubt that the perianth serves as an important organ of protection, and the manner in which the perianth, and more especially the corolla performs this function, is the subject of this note.

We may note that flowers are classifiable in a variety of ways. For example, we may describe them as simple or compound, stalked or sessile, gamopetalous or polypetalous. These divisions are of course artificial, when the position of the entire plants in the natural system is being considered, but are of use when we are dealing with flowers only.

The first point we have to determine is—Is there any relationship existing between these various conditions? and, second—What is the comparative value of these several conditions looked at from the special aspect with which we are at present engaged?

It may be best to examine the several conditions one by one.

1. What will be the action of wind on a polypetalous flower?

Obviously the effect will differ, according as the flower does or does not possess a flower stalk. If the flower be sessile, then efficient protection will be best obtained by long petals, for these will, as the wind blows, fold over and shield the ripe anthers from injury, or from being robbed of their pollen. If, on the other hand, the flower be stalked, or if the branches bearing the flowers be delicate, then the flower, being anchored by its proximal end will turn round and present its back to the wind. Further, the petals will overlap each other, and so form a more or less perfect tube, carrying the current beyond the flower entirely. Manifestly polypetalous flowers with long peduncles will be best protected.

It is worth while drawing attention to the æstivation in this relation, for the more easily the petals close and the more perfect the tube or bell so formed the better the protection afforded to the andrœcium.

Another point worthy of note is that the petals are usually curved. A little careful measurement shows that that curve is nearly always a hyperbola, so that the tendency of the curve is to fend off the wind current in the best manner possible, viz. to an infinite distance. If the sides of the tube so formed were straight then there would be a tendency to form an eddy inside the flower.

2. How may one explain the form of inflorescence seen in the Compositæ?

It is quite probable that the attractive function of the corollæ has had something to do with the form of the capitulum. In short, as Grant Allen* puts it, "by thus combining their mass of bloom they are enabled to make a great show in the world, and to secure the fertilization of a great many flowers at once by each insect which visits the head." One ought to remember, of course, in

* "Flowers and their Pedigrees."

this relation the economy of labour to the bee or other nectar-loving insect: for, inflorescences, like those of the Compositæ, enable an insect to gather all the honey it needs and at the same time fertilize a large number of flowers with a minimum expenditure of energy, whilst there must be far more labour involved in gathering honey and fertilizing the florets of the laburnum inflorescence, and much more chance of the bee missing a number. Possibly this economy to the insect may have been a factor of some importance in determining that the Compositæ should be the largest and most wide spread natural order on the earth's surface. That all the florets should retain their long corolla (in this case gamopetalous) would be an instance of waste of material which nature is seldom guilty of; consequently we find in many Compositæ the outer florets (of the ray) alone retain their long corollæ, whilst the central florets (of the disc) have lost them. The outer long ligulate corollæ are sufficient to protect the inner florets from injury from wind. The action of the wind may be very well studied on the common marigold, and what has been said of the polypetalous flower may be applied also to the Compositæ head, which is so often popularly mistaken for a single flower.

3. The Gamopetalæ have been justly considered as a higher type than the Polypetalæ, and these considerations may help to show us why it is so. For if it be good for the flower to have its anthers protected from rude blasts which may blow off all the ripe pollen, of course it must be necessarily a greater protection to have a permanent tube surrounding the essential organs than a temporary one which, moreover, is slit up the sides in several places. We have an approach to the gamopetalous condition in many Polypetalæ where the calyx is more or less gamosepalous, and helps to keep the petal limbs in

position. In the true gamopetalous form of corolla, however, we have a perfect instance of the importance of the bell shape as an efficient protective organ. The hyperbolic curve is usually very distinct as say in such forms as *Campanula*, *Gloxinia*, and such like.

4. Lastly, where the flowers are sessile we frequently find special adaptations of the corolla, whether polypetalous or gamopetalous, which render strong wind innocuous to the flower. Not infrequently also the anthers and pollen are specially modified so that a minimum of pollen is lost in high winds. These special methods of protection are also common amongst those forms we have already discussed.

It is quite true that this is only one aspect of a very wide subject, whilst there are many modifying influences at work along with those I have drawn attention to. Still it seems very probable that the form of the corolla as a protective agent is of some importance, and that is all this paper is intended to show.

On the so-called HEPATIC CELLS of the EARTH-WORM (*Lumbricus terrestris*).

By A. J. Chalmers, Student of Science,

AND

R. J. Harvey Gibson, M.A., F.R.S.E.,

LECTURER ON BOTANY IN UNIVERSITY COLLEGE, LIVERPOOL.

With Plate VII.

[Read 23rd April, 1887.]

[The following notes on the much debated question as to the nature and function of the yellow cells surrounding the intestine of *Lumbricus terrestris* were compiled during the Lent term of 1886 by Mr. A. J. Chalmers, a student in the Zoological Laboratory of University College, Liverpool. My share in the paper has been confined to revising and checking his results, and to adding such general observations as these results seemed to lead to.—R. J. H. G.]

The so-called hepatic tissue of the oligochæte alimentary canal has been the subject of not a few researches, of which the chief perhaps are the following :—

Henle* describes a villous glandular envelope surrounding the intestine of many annelids, as for example in the genera, *Lumbricus*, *Lumbriculus*, and *Naïs*. Will† confirmed Henle's observations, and from a chemical examination of the tissue concluded that the cells contained elements which were undoubtedly hepatic in their nature. Siebold‡ describes a yellowish-brown or greenish-yellow

* Müller's Arch. 1837, p. 81.

† Müller's Arch. 1848, p. 508.

‡ Anatomy of the Invertebrata. 1854, p. 167.

tissue closely surrounding the whole intestinal canal. "Carefully examined," he says, "this tissue is found composed of closely aggregated glandular sacs, which empty their contents into the intestine either directly or by many common secretory ducts. The contained liquid is, with most species, a transparent fluid in which are suspended brown granules, and it resembles the bile of the higher animals."

Claparède* describes yellow cells as arranged round the vessels opening into the dorsal vessel, but throws no light on their function beyond saying that, in his opinion, they do not give rise to the corpuscles of the cœlomic fluid as stated by some observers.

Ray Lankester† does not consider the corresponding cells in the leech as hepatic at all, but believes them to be "vasifactive." Beddard‡ describes the yellow cells of *Pleurochæta moseleyi* as simply cells lining the cœlomic cavity, and not opening into the alimentary canal at all.

The yellow cells are also briefly referred to by Perrier.§

In the text books these statements reappear, with or without criticism. Huxley,‖ for example, merely remarks that "the exterior of the intestine and the cavity of the typhlosole present a coating of yellowish-brown cells." Marshall and Hurst¶ describe the "hepatic cells" as being "a layer of yellow cells surrounding the intestine, and in close relation with blood vessels. Their function

* Recherches anatomiques sur les Oligochètes, Mem. de la Soc. de Phys. de Genève. Vol. xvi., p. 217.

† "On the Vasifactive and Connective Tissues of the Medicinal Leech." Q. J. M. S., vol. xx., 1880.

‡ The Anatomy and Histology of *Pleurochæta moseleyi*. Trans. Roy. Soc., Ed., vol. xxx., pt. ii.

§ F. Perrier, Organisation des Lombriciens Terrestres, Arch. d. Zool. Exper., iii., 1874.

‖ Anatomy of Invertebrated Animals. 1877, p. 223.

¶ Practical Zoology. 1887, p. 61.

is unknown. They are elongated granular cells of large size, and arranged generally radially to the surface of the intestine. They are very abundant in the cavity of the typhlosole, which they almost completely fill."

Lloyd Morgan* says, "Surrounding the intestine, especially at its anterior end, is a yellowish-brown, easily ruptured tissue, which is in close connection with the blood vessels. Similar tissue may accompany the dorsal vessel above the œsophagus. It has been described as hepatic, and as producing a digestive secretion. It nowhere communicates, however, with the interior of the canal, and its close connection with the blood vessels lends support to the view that it is vasifactive—concerned in the production of some constituent of the red fluid of the blood vessels."

Howes† affirms that "the brownish-yellow tissue, usually termed liver, has no direct connection with the lumen of the alimentary canal. It is always associated very largely with the blood vessels, and is in all probability a direct derivative of their walls. It appears to be active in the production of some constituent of the blood, similarly to that tissue described by Lankester in the leeches as *vasifactive*."

No very definite account or good figures are to be found of these cells in any of the papers or text books above quoted, so that it may not be out of place to summarise the main features of this functionally doubtful tissue.

The cellular layer is distinctly visible, through the body wall, when the animal is stretched and under water, as a yellow-brown streak, particularly at the posterior end of the body. On dissection, generally speaking, the yellow cellular investment extends from the first "pseudoheart"

* Animal Biology. 1887, p. 283.

† Atlas of Biology. 1885, p. 49.

to the end of the dorsal blood vessel in the very last somite of the body. The cells are few in number until the posterior end of the gizzard is reached, then they suddenly increase very greatly in amount. They entirely surround the intestine throughout the greater part of its length. At the beginning of the last quarter of the intestine the cells rather sharply diminish in number, and appear only on the dorsum of the intestine in proximity to the dorsal blood vessel, and surrounding the lateral branches of that vessel. Finally they exist merely as a streak on the median dorsal line until the last somite is reached.

In colour the cells are from orange to a dark yellowish brown.

The cells which surround the intestine directly posterior to the gizzard may be divided, according to colour and arrangement, into three distinct areas.

(*a*) A mass of cells directly surrounds the dorsal blood vessel, and is continuous with those surrounding the blood vessel more anteriorly.

(*b*) On the dorsum of the intestine, and radiating outwards from the cells surrounding the dorsal blood vessel, and passing down the sides of the intestine, are, in each somite, two pairs of cellular masses, of a dark orange or brown colour directly behind the gizzard, but becoming lighter in colour backwards, until in the posterior somites of the body they become the same colour as those of the dorsum.

(*c*) Further, more ventrally placed on either side of the intestine, there is one distinct mass of light yellow colour.

Just behind the gizzard the cells do not cover the inferior surface of the intestine, but they do so a little further back, the two ventrolateral masses in each somite being separated by the sub-intestinal blood vessel, which is (unlike the dorsal vessel) not imbedded in the cellular layer, but lies free (Pl. VII., fig. 1). This arrangement obtains for about three quarters of the length of the intestine. In the last quarter, no distinct lateral masses are to be seen, the cells being chiefly aggregated round the dorsal blood vessel.

The cells round the dorsal blood vessel above and in front of the gizzard are small and few in number.

When a piece of the alimentary canal is teased in water, or weak glycerine, the cells are seen to consist of an elongated oval body (figs. 4 and 5), from which proceeds a long process, which in its course usually shews an ampulla-like swelling. The process, after passing between the muscular fibres surrounding the intestine, becomes lost among the young cells lying between the bases of the columnar ciliated epithelial cells lining the intestinal wall (figs. 2 and 3). The body of the unicellular gland, the duct-like projection and its ampulla, when examined under Gundlach's 1-12th inch objective, are found to be full of minute yellowish rounded granules of variable size, perfectly homogeneous in structure (fig. 6).

The cells are much longer on the dorsal surface than on the ventral. They are especially long in the typhlosole.

With regard to their function, despite the doubts thrown on their hepatic nature, we are inclined to think that the balance of evidence leads to that view rather than to any other which has been advanced.

In the first place, their distribution at once suggests digestive or absorptive duty.

Again, the contents of the intestine, as stated by Darwin,* are distinctly acid, although the pharynx is alkaline and the gizzard very slightly acid. We found the reaction of these cells and of the outer surface of the

* Vegetable Mould and Earth Worms. 1883, p. 52.

intestine to be distinctly acid. The termination of the cells among the bases of the columnar epithelium likewise points to the digestive function of the yellow cells; and, although we have not been able to see the actual ends of the cells, yet it seems probable that the granules contained in the cells escape into the intestine through the columnar epithelium (as Siebold originally pointed out), which is composed of cells with considerable intercellular spaces not filled by cement substance. The intestinal contents include large quantities of rounded granules precisely similar to them, although it would be rash to say that they are identical with the granules of the yellow cells.

Further, save the calciferous glands, there are no recognised digestive glands in the worm, and the yellow cells would naturally appear to fulfil that function.

Again, there is no obvious connexion between the blood vessels and these cells; for not only do many of the vessels want such investments, but there is no direct connection between the vessels and the cells. The accounts given of the said relation are very vague (see above).

We hope to publish, ere long, further details with regard to the chemical character of the cells, and their functions.

Explanation of Plate VII.

Fig. 1. Diagrammatic transverse section of *Lumbricus terrestris*, through the middle of the body.

a, Body wall; *b*, muscular layer; *c*, cœlome; *d*, pit for setæ; *e*, opening of nephridium; *f*, yellow cellular layer of the intestine; *g*, columnar epithelial layer of intestine; *h*, yellow cells in typhlosole; *i*, dorsal blood vessel; *k*, vessel and connective tissue in typhlosole; *l*, ventral blood vessel; *m*, nerve cord; *n*, subneural blood vessel.

Fig. 2. Relation of the yellow cells to the intestinal wall.

Fig. 3. Ditto, in the typhlosole.

Fig. 4. Various forms of yellow cells.

Fig. 5. Yellow cell, showing ampulla.

Fig. 6. Contents of a yellow cell.

Figs. 2 and 3 are drawn under the same eye-piece Hartnack 3, objective 7; figs. 4, 5 and 6, under the same eye-piece, Gundlach objective 1-12th.

A WARM-WATER TANK for ACCELERATING OSTEOLOGICAL MACERATION.

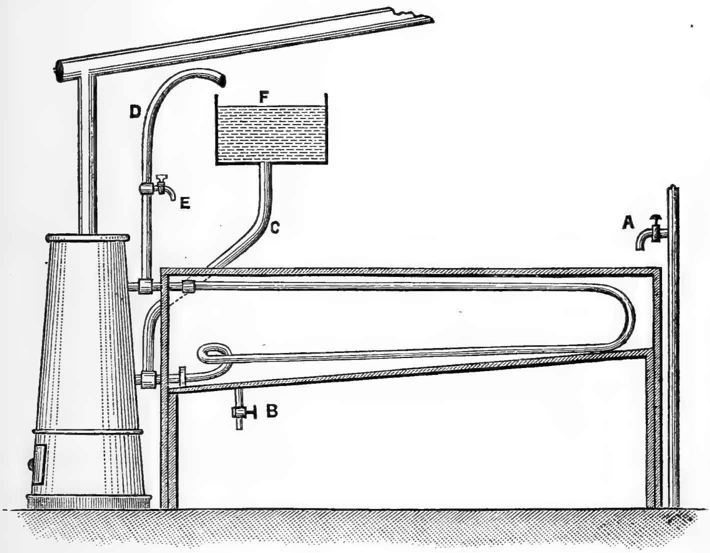
By G. Fred. Moore,

of Moore Brothers, Osteologists, Liverpool); late Demonstator of Zoology, University College, Liverpool.

[Read 23rd April, 1887.]

The importance of skeletons to students of the Vertebrata will not be questioned, but in order that the skeletons may be studied with comfort and ease it is necessary to have them properly prepared. Maceration is one of the first steps in the preparation, and all methods of assisting or improving this, with the object of retaining the natural colour and condition of the bones, are worth recording. In 1884, Dr. Struthers published in the *Journal of Anatomy and Physiology* (vol. xviii., p. 49) a paper describing his warm-water tanks, and when reading this lately, I thought that some zoologists, wishing to try to macerate their own specimens, might like to hear of a much more simple and less expensive method of building a tank to serve the same purpose. I will therefore describe the one which my brother and I have had in continual use for nearly two years, and which has been even more successful than we had anticipated with all kinds of animals, from a sparrow to an ostrich, and a mouse to a horse.

The tank is made of rough spruce boards, 7 inches wide and 1 inch thick, nailed to battens of the same thickness. It is 7 feet long, 2 feet wide, 18 inches deep at the deeper end, shallowing to 8 inches, and is raised about 7 inches from the floor at its deeper end to give room for working the outlet. This wooden case is lined with sheet zinc, fitted closely, and beaten down over the top edges. At the deeper end is the outlet, covered with a convex rose; the supply tap being at the shallow end. From the outlet a $1\frac{1}{2}$ inch leaden pipe, regulated by an ordinary stopcock, runs directly into the drain, down which, previously to emptying the tank, we pour chloride of lime and carbolic acid to minimise, as far as possible, any unpleasant odour.



A. Supply pipe to the tank.
B. Stopcock and outlet.
C. Hot-water supply pipe from the cistern F.
D. Steam escape.
E. Tap for regulating the hot water.

The old method of macerating in tubs and earthenware jars could never be carried on in comfort in close vicinity to dwelling houses, as in carrying the vessels about to pour away the water a very considerable odour would be raised which might at any time incline the neighbours to appeal to the sanitary authorities and make things generally unpleasant. In order to avoid this we used to go to our old laboratory at midnight, when we concluded that anybody still out of bed would most likely be too drowsy to notice the insinuating perfume, and empty our jars as quietly as possible; but these stealthy midnight visits are now needless since the present tank has been in use, for the water sinks gradually and without disturbance, giving off very little smell, which is overcome by the disinfectants I have named.

The water in the tank is warmed by a No. 1 Star Boiler placed at its deep end. The hot-water pipe (1 inch high pressure) is connected with the boiler by a double brass union, which, being the highest point, gives off, before entering the tank, the escape pipe of 1 inch diameter. After entering the tank the pipe runs close to the sides, resting on a narrow wooden support made to fit tightly and supported by wooden blocks; the pipe runs thus along the back, one end and the front, having a slight fall all the way, then makes a rather large loop, and is joined to another double brass union, which receives the supply pipe from the cistern, and then runs into the boiler, thus completing the circle. Where the unions pierce the end of the tank they are packed, and screwed very tightly against the zinc to prevent leakage.

The cistern, an iron one, is 18 inches long by 9 wide and 12 deep; the supply pipe is carried slightly above the level of the bottom to keep grit and dirt out of the boiler, then goes to join the return hot-water pipe, as we have seen; the steam escape pipe is bent over the cistern so that the condensed steam may drop into it.

The water in the tank should be kept at a warm temperature, not hot, or the flesh will all leave the bones, and they will appear to be ready before the grease and blood have quite left them. If by accident the water has been allowed to get too hot—anything above 95° Fahr. being too hot—cold water should be added to reduce it. For this purpose also there is a tap from the steam escape by which we draw off the hot water, while adding cold to the cistern.

The water should be changed regularly, say once a week, if there are many animals in the tank. If a large animal be put in, the water should be changed daily for the first three days, until most of the blood is removed, for bones are never a really good colour if left in water with a quantity of blood and grease. For this reason the tank should be examined every morning, and all floating grease skimmed off, and after emptying it should have a scrub down, and all grease and scraps should be cleared out. Of course all bones are not the same colour, and one does not want to get them white (except snakes and birds), a good cream is the average colour; strange to say, many bones that are positively *black* in maceration turn out of the best colour.

The tank has a lid made of the same kind of boards as the sides, battened together and hinged. It might have been made of lighter wood, but being strong it serves for a good table. When we first used the tank we had moveable partitions, each with a semi-circular piece cut out, and perforated zinc put in to let the water pass through, but we found them very inconvenient when we had many large animals in. Afterwards, although there is little risk of confusing the bones of different animals, we used, when there were more than one of the same kind of animal in, to tie all the parts of each individual together, but we found when the phalanges and smaller bones dropped off it took a considerable time to sort them. Finally we had perforated zinc boxes made, which have proved very useful; the bottom and sides are of one piece, the ends are soldered on, and four knobs at the bottom serve to reduce wear; the lid is made a good fit, and has two rolls of zinc soldered on to serve as rests when it is used as a draining tray. A handle is placed at each end for convenience of lifting. We have these boxes made in different sizes—one, 8 inches long by 4 wide and 6 deep, does for small monkeys, birds, rats, &c., a little larger size will take hands and feet, &c., and so on. These zinc boxes would also do very well for macerating in a running stream.

A tank the size I have mentioned would be large enough for most institutions, as may be gathered from our having recently macerated in it the following animals at one time:—Full grown Nylghau, Tapir, two Greyhounds, large Mastiff, Indian Antelope, fairly large Ourang, young Gorilla, Spider Monkey, Galago, Douroucouli, large Python, Pelican, Duck, Sarras Crane, &c.

Notwithstanding the great assistance warm water gives, many animals take a surprisingly long time to macerate, which, like many other things, can only be done successfully with much patience and probably after many failures. The horse skeleton in the Equestrian Group now in the Liverpool Museum, was macerated in the tank just described for six or seven months, although, unlike most horse skeletons, this one was not particularly greasy.

I may, perhaps, having had a pretty large experience, reckoned by animals rather than years, advise any one intending to attempt maceration not to try young or rare beasts until they have had some experience with larger common ones.

PRELIMINARY PAPER on a COLLECTION of SIMPLE ASCIDIANS from AUSTRALIAN SEAS.

By Fanny D. Palethorpe and Charlotte Wilson.

With Plate VIII.

[Read 23rd April, 1887.]

The present collection of Ascidians was exhibited, on behalf of the Australian Museum, Sydney, at the Fisheries Exhibition, London, in 1883, and was afterwards sent to Professor Herdman to be examined and worked up. The collection then lay for a couple of years in the Zoological Laboratory of University College, Liverpool. During the summer of 1886, when working as advanced students in the Laboratory, we commenced the examination of the specimens, under Professor Herdman's superintendence, and during the present summer one of us has been engaged in carrying on the work.

The Australian seas are known to contain a rich Ascidian fauna—over fifty species of Simple Ascidians having already been described from that region. They represent three out of the four known families, namely, the *Cynthiidæ*, the *Molgulidæ*, and the *Ascidiidæ*. So far, no specimens of Social Ascidians belonging to the fourth family—*Clavelinidæ*—have been described from Australia. The discovery of twenty-four of these species was the result of the "Challenger" investigations.* The remainder have been described by various authors:—Heller, Stimpson, McDonald and others.

This particular collection was found, on examination, to

* See "Zool. Chall. Exp.," pt. xvii., 1882,

contain twenty-six species of Simple Ascidians, some of them represented by a large number of specimens.

Of these twenty-six species, thirteen have been identified as belonging to species already known and described. Two of them belong to the interesting genus *Boltenia*, namely, *Boltenia gibbosa* and *B. pachydermatina*, the latter species containing some of the largest known specimens of Simple Ascidians. Ours, however, were only of moderate size. The other eleven known species are *Microcosmus julinii*, *M. variegatus*, *M. affinis* and *M. distans*, *Cynthia grandis* and *C. præputialis*, *Styela gyrosa* and *S. squamosa*, *Polycarpa tinctor*, *P. longisiphonica* and *P. viridis*.

Boltenia gibbosa was described by Heller,* who makes no mention of spicules in the test. Our specimen, however, shows numerous calcareous spicules in the test, which vary in shape from simple bars to stellate figures (Pl. VIII., fig. 2).

We have also found in the transverse vessels and internal longitudinal bars of the branchial sac of *Boltenia pachydermatina* spicules which resemble those which seem so highly characteristic of the nearly allied genus *Culeolus*, but no reference has ever been made to the occurrence of these kinds of spicula in the genus *Boltenia*. In shape they are generally fusiform, occasionally bifurcating, or even assuming a tri-radiate form (Pl. VIII., fig. 1). This *Boltenia* is apparently a common species in Southern Seas, and specimens of it have long been known in museums, but it had never been examined until lately, when it was first described and named by Professor Herdman, in his Report on the "Challenger" Collection. Since then it has been made the subject of further investigation by Dr. R. von Drasche.†

* "Sitzb. k. Akad. Wiss.," Bd. lxxvii., 1878.

† "Denksch. k. Akad. Wiss." Wien, Bd. xlviii., p. 370, 1884.

The three known species belonging to the genus *Polycarpa* show a good deal of individual variation in the arrangement of the blood vessels forming the transverse vessels of the branchial sac, and also in the number of the stigmata in the meshes of the sac. The arrangement of the vessels forming the internal longitudinal bars of the sac is, however, generally supposed to be a constant character, but in one specimen of *Polycarpa tinctor* examined, only *four* internal longitudinal bars were present between each pair of folds of the sac, whereas the species has previously been described as possessing eight.*

Perhaps one of the most interesting points in the anatomy of Ascidians is the "dorsal tubercle," the careful examination of which, throughout the group, will help to throw, it is hoped, a little light on the question whether the dorsal tubercle is, or has been, anything more than merely the aperture of the duct from the neural gland, which is supposed to be the homologue of the pituitary body of the higher chordata. The dorsal tubercle is always liable to a considerable amount of individual variation.

In *Polycarpa tinctor*, both horns, as the lips round the ends of the aperture are called, normally form spirals. In one specimen, however—the same which shewed a variation in the branchial sac—the left horn seems to have remained entirely uncoiled, and appeared almost as a straight line directed outwards from the side of the tubercle (Pl. VIII., fig. 3). There are a good many specimens of this species in the collection, so we hope to examine the others and find if they are more normal in this respect.

In a few of the undescribed species the dorsal tubercle has rather a remarkable form. This is especially the case

* "Challenger Reports," vol. vi., pt. xvii., p. 170.

in one *Polycarpa*, in which the horns are symmetrical, and first turn in and then out again—a very unusual condition (Pl. VIII., fig. 5).

In another *Polycarpa* the tubercle was nearly circular in outline, and apparently much complicated by the development of lateral branches from the original slit, which made the surface appear marked with rather a grotesque pattern (Pl. VIII., fig 4). In such a form it is difficult to trace its derivation from a simple circular opening.

Altogether there are thirteen species which we have not yet been able to identify. The majority of them evidently belong to the genus *Polycarpa;* but, on a more detailed examination, many of them will, most probably, turn out to be new species, which will have to be thoroughly described, figured, and named, and we hope to have an opportunity at some future meeting, when our work is completed, of giving an account of these new species to the Society.

Explanation of Plate VIII.

Fig. 1. Part of the branchial sac of *Boltenia pachydermatina* showing spicules in a transverse vessel. Highly magnified (300 diam.)

Fig. 2. Various forms of spicule from the test of *Boltenia gibbosa*. Highly magnified.

Fig. 3. The dorsal tubercle of *Polycarpa tinctor*. Abnormal specimen. Magnified (50 diam.)

Fig. 4. The dorsal tubercle of an undescribed species of *Polycarpa*. Magnified.

Fig. 5. The dorsal tubercle of another new species of *Polycarpa*. Magnified.

SURFACE ANIMALS collected in MALTESE SEAS during 1886—7.

By David Bruce, M.B.

[Read 23rd April, 1887.]

Professor Herdman exhibited a collection of surface animals from the Mediterranean, which had recently been sent to the Zoological Laboratory for examination. The collection had been made by Surgeon Bruce, M.B., Edin., who, while stationed at Valetta, Malta, had taken every favourable opportunity of using the tow-net.

There were altogether fifty-seven bottles sent by Dr. Bruce, each bottle representing a separate gathering, and the whole extending over one year, from 23rd January, 1886, to 24th January, 1887; so that from an examination of the collection a very good idea could be obtained of the Maltese surface fauna at all seasons.

The specimens were preserved, some in spirit after hardening in picric acid, and the rest in Mr. Thompson's preservative fluid, composed of equal parts of water, spirit and glycerine, with 1 per cent of carbolic acid added. They are all apparently in an excellent state of preservation.

A rapid preliminary examination of the series of bottles shows that the specimens collected range over the following groups:—

Protozoa (Radiolaria.)
Cœlenterata (Medusæ, Siphonophora.)
Vermes (*Sagitta.*)

Crustacea (Copepoda, Cirripedia, Isopoda, Schizopoda, &c.)
Mollusca (Heteropoda, Pteropoda.)
Tunicata (*Appendicularia*, *Salpa.*)
Vertebrata (Fish ova and embryos.)

There is apparently a considerable difference both in the numbers and the kinds of animals in the different bottles, some of the groups being evidently more abundant at certain times than at others.

This collection, from its extent and the care with which it has been made, will supply particularly favourable material for working out the distribution of the more important groups of surface animals in the neighbourhood of Malta. Mr. I. C. Thompson has already commenced the examination of the Copepoda, and it is hoped that other specialists will be found who are willing to separate out and identify the remaining groups.

On the DISCOVERY of SPONGE SPICULES in the CHERT BEDS of FLINTSHIRE.

By G. H. Morton, F.G.S.

[Read 23rd April, 1887.]

A few months ago, while preparing specimens for a paper on "The Microscopic Characters of the Cefn-y-Feda Sandstones of Denbighshire and Flintshire,"* I was so fortunate as to discover Sponge spicules in the Chert-beds overlying the Carboniferous Limestone near Chirk, Holywell and Prestatyn. The Chert at the two latter places is about 250 feet thick, and is probably the greatest deposit of Sponges in Britain. The spicules consist of minute rods, which are frequently so numerous as to cross and interlace each other and form a felted moss, which is particularly well seen in some weathered specimens.

Recently, Dr. G. J. Hinde, F.G.S. has found similar spicules in the Carboniferous Chert of Yorkshire and Ireland, and he has visited the localities in Flintshire, and confirmed my discovery by collecting specimens for himself. Dr. Hinde states, that "The preservation of the Sponge-remains in the Irish Carboniferous Chert is much less favourable than in the corresponding Chert-beds of the Yoredale series in Yorkshire and North Wales; the spicules are far more eroded, and consequently it is more difficult to determine their characters. Most of these spicules probably belong to the Monactinellidæ, though some of the larger forms may be those of Tetractinellid Sponges."† Only the spicules occur, and no perfect Sponge has yet been found.

* "Proc. L'pool Geol. Soc.," vol. v., p. 271.

† "Organic Origin of Chert." Geol. Mag., Ser. iii., vol. iv., p. 435.

LAWS

OF THE

LIVERPOOL BIOLOGICAL SOCIETY.

I.—The name of the Society shall be the "Liverpool Biological Society," and its object the advancement of Biological Science.

II.—The Ordinary Meetings of the Society shall be held at University College, at Eight o'clock, during the six Winter months, on the second Saturday evening in every month, or at such other place or time as the Council may appoint.

III.—The business of the Society shall be conducted by a President, two Vice-Presidents, a Treasurer, a Secretary, and twelve other Members, who shall form a Council; four to constitute a quorum.

IV.—The President, Vice-Presidents, Treasurer, Secretary, and Council shall be elected annually, by ballot, in the manner hereinafter mentioned.

V.—The President shall be elected by the Council (subject to the approval of the Society) at the last Meeting of the Session, and take office at the ensuing Annual Meeting.

VI.—The mode of election of the Vice-Presidents, Treasurer, Secretary, and Council shall be in the form and manner following:—It shall be the duty of the retiring Council at their final meeting to suggest the names of Members to fill the offices of Vice-Presidents, Treasurer, Secretary, and of four Members who were not on the last Council to be on the Council for the ensuing session, and formally to submit to the Society, for election at the Annual Meeting, the names so suggested. The Secretary shall make out and send to each Member of the Society, with the circular convening the Annual Meeting, a printed list of the retiring Council, stating the date of the election of each Member, and the number of his attendances at the Council Meetings during the past session; and another containing the names of the Members suggested for election, by which lists, and no others, the votes shall be taken. It shall, however, be open to any Member to substitute any other names in place of those upon the lists, sufficient space being left for that purpose. Should any list when delivered to the President contain other than the proper number of names, that list and the votes thereby given shall be absolutely void. Every list must be handed in personally by the Member at the time of voting. Vacancies occurring otherwise than by regular annual retirement shall be filled by the Council.

VII.—Every Candidate for Membership shall be proposed by three or more Members, one of the proposers from personal knowledge. The nomination shall be read from the Chair at any Ordinary Meeting, and the Candidate therein recommended shall be balloted for at the succeeding Ordinary Meeting. Ten black balls shall exclude.

VIII.—When a person has been elected a Member, the Secretary shall inform him thereof, by letter, and shall at the same time forward him a copy of the Laws of the Society.

IX.—Every person so elected shall within one calendar month after the date of such election pay an Entrance Fee of Half a Guinea and an Annual Subscription of One Guinea (except in the case of Student Members); but the Council shall have the power in exceptional cases, of extending the period for such payment. No Entrance Fee shall be payable by Members elected before October, 1887, or on the re-election of any Member who has already paid one such fee.

X.—The Subscription (except in the case of Student Members) shall be One Guinea per annum, payable in advance, on the day of the Annual Meeting in October.

XI.—Members may compound for their Annual Subscriptions by a single payment of Ten Guineas.

XII.—There shall also be a class of Student Members, paying an Entrance Fee of Two Shillings and Sixpence, and a Subscription of Five Shillings per annum.

XIII.—Resignation of Membership shall be signified *in writing* to the Secretary, but the Member so resigning shall be liable for the payment of his Annual Subscription, and all arrears up to the date of his resignation.

XIV.—The Annual Meeting shall be held on the second Saturday in October, or such other convenient day in the month as the Council may appoint, when a Report of the Council on the affairs of the Society, and a Balance Sheet, duly signed by Auditors previously appointed by the Council, shall be read.

XV.—Any person (not resident within ten miles of Liverpool) eminent in Biological Science, or who may have rendered valuable services to the Society, shall be eligible as an Honorary Member; but the number of such Members shall not exceed fifteen at any one time.

XVI.—Captains of vessels and others contributing objects of interest shall be admissible as Associates for a period of three years, subject to re-election at the end of that time.

XVII.—Such Honorary Members and Associates shall be nominated by the Council, elected by a majority at a General Meeting, and have the privilege of attending and taking part in the Meetings of the Society, but not of voting.

XVIII.—Should there appear cause in the opinion of the Council for the expulsion from the Society of any Member, a Special General Meeting of the Society shall be called by the Council for that purpose; and if two-thirds of those voting agree that such Member be expelled, the Chairman shall declare this decision, and the name of such Member shall be erased from the books.

XIX.—Every Member shall have the privilege of introducing one visitor at each Ordinary Meeting. The same person shall not be admissible more than twice during the same session.

XX.—Notices of all General or Special Meetings shall be issued to each Member by the Secretary, at least three days before such Meeting.

XXI.—The President, Council, or any ten Members can convene a Special General Meeting, to be called within fourteen days, by giving notice in writing to the Secretary, and stating the object of the desired Meeting. The Circular convening the Meeting must state the purpose thereof.

XXII.—Votes in all elections shall be taken by ballot, and in other cases by show of hands, unless a ballot be first demanded.

XXIII.—No alteration shall be made in these Laws, except at an Annual Meeting, or a Special Meeting called for that purpose; and notice in writing of any proposed alteration shall be given to the Council, and read at the Ordinary Meeting, at least a month previous to the meeting at which such alteration is to be considered, and the proposed alteration shall also be printed in the Circular convening such meeting; but the Council shall have the power of enacting such Bye-laws as may be deemed necessary, which Bye-laws shall have the full power of Laws until the ensuing Annual Meeting, or a Special Meeting convened for their consideration.

BYE-LAW.

All nominations of Student Members shall be passed by the Council previous to nomination at an Ordinary Meeting. When elected, Student Members shall be entitled to all the privileges of Ordinary Members, except that they shall not receive the publications of the Society, nor vote at the Meetings, nor serve on the Council.

LIST OF MEMBERS

OF THE

LIVERPOOL BIOLOGICAL SOCIETY.

SESSION 1887—8.

A. Ordinary Members.

(Life Members are marked with an asterisk.)

Atkin, Hope T., Egerton House, Egerton Park, Rock Ferry.
Banks, Prof. W. Mitchell, M.D., F.R.C.S., 28, Rodney-street.
Bark, John, M.R.C.S., 42, Balliol-road, Bootle.
Barron, Alexander, M.B., M.R.C.S., 31, Rodney-street.
Beasley, Henry C., Prince Alfred-road, Wavertree.
Caine, Nathaniel, 10, Orange-court, Castle-street.
Capon, Robert M., L.D.S., Rodney-street.
Caton, Prof. R., M.D., F.R.C.P., 18, Croxteth-road.
Chisholm, J. M., M.D., White House, Woolton.
Collins, A. W., M.B., 7, Rodney-street.
Craig, Robert, 7, Clarendon-road, Garston.
Dillcock, T., Egremont.
Drysdale, John, M.D., President, 36a, Rodney-street.
Edmonds, William, 69, Albany, Oldhall-street.
Ellis, J. W., L.R.C.P., F.E.S., 3, Brougham-terrace.
Gasking, Rev. S., B.A , F.G.S., 78, Brae-street, Edge-lane.
Glynn, Prof., M.D., M.R.C.P., 62, Rodney-street.
Gibson, R. J. Harvey, M.A., F.R.S.E., Secretary, University College.
Gatehouse, C., 74, Bidston-road, Birkenhead.
Halhed, W. B., Sunnyside, Prince's Park.
Halls, W. J., 35, Lord-street.
Hanitsch, R., Ph.D., Zoological Laboratory, University College.
Hayward, J. W., M.D., 117, Grove-street.

Haywood, A. G., Reasby, Blundellsands.
Healey, George F., Oakfield, Gateacre.
Herdman, Prof. W. A., D.Sc., F.L.S., F.R S.E., Vice-President, University College.
Hewitt, W., B.Sc., 16, Clarence-road, Birkenhead.
Higgin, T., F.L.S., Ethersall, Roby.
Hill, G. H., 23, Selborne-street.
Jones, Charles W., Field House, Prince Alfred-road, Wavertree.
Larkin, F. C., M.R.C.S., Physiological Laboratory, University College.
Leicester, Alfred, 24, Aughton-road, Birkdale.
Lightbody, J. H., Royal Infirmary.
Lomas, J., Assoc. N.S.S., 23, Selborne-street.
Melly, W. R., Grossbeeren St. 74$^{\text{III.}}$, Berlin.
McMillan, William S., F.L.S., Brook-road, Maghull.
McClelland, Joseph, M.D., 7, Sefton-drive, Sefton Park.
Moore, Thomas J., C.M.Z.S., Free Museum.
Moore, G. F., 15, Kremlin-drive, Tuebrook.
Morton, G. H., F.G.S., 209, Edge-lane, E.
Narramore, W., 5, Geneva-road, Elm Park.
*Poole, Sir James, J.P., Vice-President, Abercromby Square.
Rathbone, Theodore, F.L.S., Backwood, Neston.
Read, William H., 24, Fern-grove.
Rheam, W., B.Sc., Polmont, N.B.
Roberts, I., F.G.S., Kennessee, Maghull.
Robertson, Helenus R., Glendaragh, Livingstone-drive.
Rose, Fred., L.D.S., L.R.C.S.Eng., The Grove, Lower Bebington.
Ryley, Thomas C., 31, Alexandra-drive.
Slater, S., 48, Nelson-street.
Smith, Andrew T., Jun., 13, Bentley-road, Prince's Park.
Tate, A. Norman, F.I.C., 9, Hackins-hey.
Thompson, Isaac C., F.L.S., F.R.M.S., Treasurer, Woodstock, Waverley-road.
Vicars, John, 8, St. Albans-square, Bootle.
Walker, Alf. O., J.P., F.L.S., Leadworks, Chester.
Walker, George, F.R.C.S., 43, Rodney-street.

B. Student Members.

Armstrong, Miss A., 26, Trinity-road, Bootle.
Baylis, W. J., 56, Vine-street.
Bell, W., 5, Drysdale-road, Edge-lane.
Browne, H. J. M., 39, Rodney-street.
Chalmers, A. J., West Bank, Waterloo-road, Waterloo.
Clapham, G. P. P., 13, Ducie-street.
Clubb, J. A., Zoological Laboratory, University College.
Conroy, J. T., 10, Radnor-place, Tuebrook.
Dalton, David, 26, Trinity-road, Bootle.
Dalton, Mrs., do. do.
Davies, Benjamin, Physical Laboratory, University College.
Dickinson, Thomas, 3, Clarke-street.
Earnshaw, W. H., Leavy Greave, Rudgrave-place, Egremont.
Edgecombe, W., Uplands, Blundellsands.
Evans, John, 7, Elm Bank, Walton Breck-road, Anfield.
Gould, Joseph, Holly Lodge, Cunard-road, Litherland.
Hannah, J. H. W., 4, Adderley-street, Edge-lane.
Harding, Miss M., Kremlin-drive, West Derby.
Hornell, James, 105a, Grove-street.
Hughes, W. Rathbone, 3, Prince's-gate, Prince's Park.
Inman, J. H., 49, Rocky-lane, West Derby-road.
Jones, C. R., St. John's Vicarage, Waterloo.
Jones, Miss M., Summerhill House, Litherland.
Joynson, Robert, 63, Tunnel-road.
Marrow, P. H., 7, Bell-road, Seacombe.
McLachlan, Robert, 28, Ruby-street, Dingle.
McMillan, R., 34, Salisbury-street.
Moore, E., 16, Queen's-road, Southport.
Nixon, J. P., 40, Spellow-lane, Kirkdale.
Noble, Miss Jessie, 83, Brook-road, Bootle.
O'Brien, Miss Mary, 47, Kingsley-road.
Palethorpe, Miss F., 85, Gladstone-road, Edgehill.
Partridge, A. J., 25, Seacombe Villas, Seacombe.
Peters, T. J., 10, Brookland-street, Stoneycroft.

Porter, A. W., 21, Willow Bank-road, Devonshire Park, Birkenhead.
Putt, D. F., 43, Grey-road, Walton.
Quehen, E., Argo-road, Waterloo.
Robinson, H., Physical Laboratory, University College.
Rowlands, W. Ellison, 28, Green-lane, Stoneycroft.
Schweizer, W., 2, Ashfield, Wavertree.
Small, Laurence, 71, Geraint-street.
Spencer, Edward, 36, St. James's-road.
Tarbet, W. E., 8, Gambier-terrace.
Tarleton, Thomas, 1, Hyde-road, Waterloo.
Teare, J., 9, Venmore-street, Everton.
Thomson, David, 36, St. Hilda-street.
Wells, Miss C., 46, Berkley-street.

C. Honorary Members.

H.M. King Kalakao, the Palace, Honolulu, Sandwich Islands.
Marshall, Prof. A. Milnes, D.Sc., M.D., F.R.S., Owens College, Manchester.

LIVERPOOL BIOLOGICAL SOCIETY,

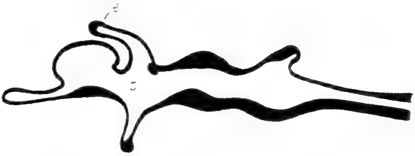
Dr. — In Account with ISAAC C. THOMPSON, Hon. Treasurer. — Cr.

1887.	£	s.	d.	1887.	£	s.	d.
To Tea and Attendance at Meetings	2	10	2	By 54 Members' Annual Subscriptions at 21s	56	14	0
,, Teachers' Guild, share of Furniture, Crockery, &c.	3	9	11	,, 35 Student Members' do. at 5s	8	15	0
,, Printing and Stationery	4	11	6	,, 1 Life Member's Subscription	10	10	0
,, Postages per Secretary	2	14	7				
,, Do. Treasurer	1	0	0				
,, Balance carried forward	61	12	10				
	£75	19	0		£75	19	0
				Balance in hands of Treasurer	£61	12	10

ISAAC C. THOMPSON,
Hon. Treasurer.

Audited and found correct,
ALFRED LEICESTER.
J. LOMAS.

Liverpool, 29*th October*, 1887.



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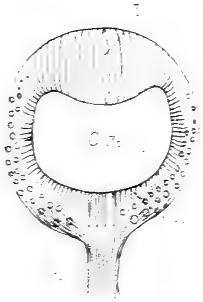
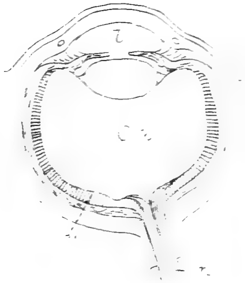


Fig. 3



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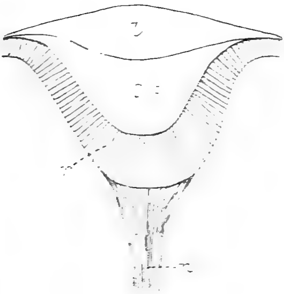

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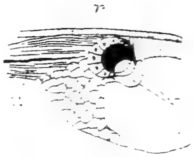

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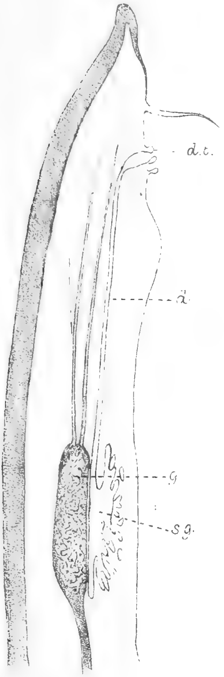

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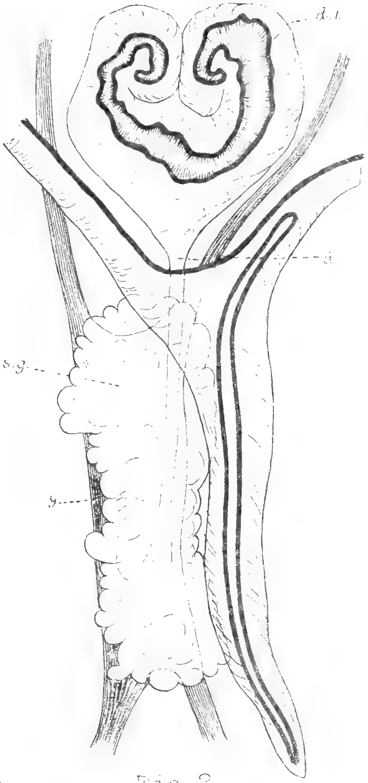

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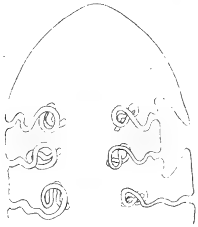

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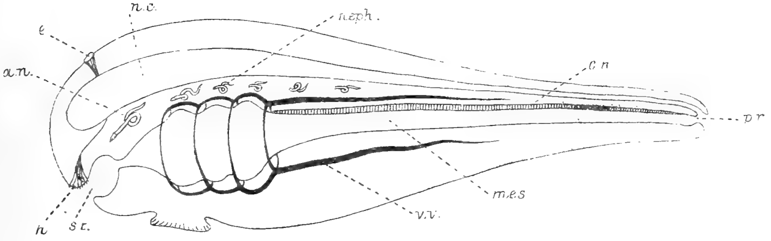


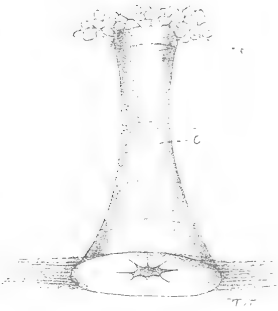
Fig. 4.

W.A.H. del.
Parker & Coward, lith.

West, Newman & Co. imp.

Fig. 1.

Fig. 2.



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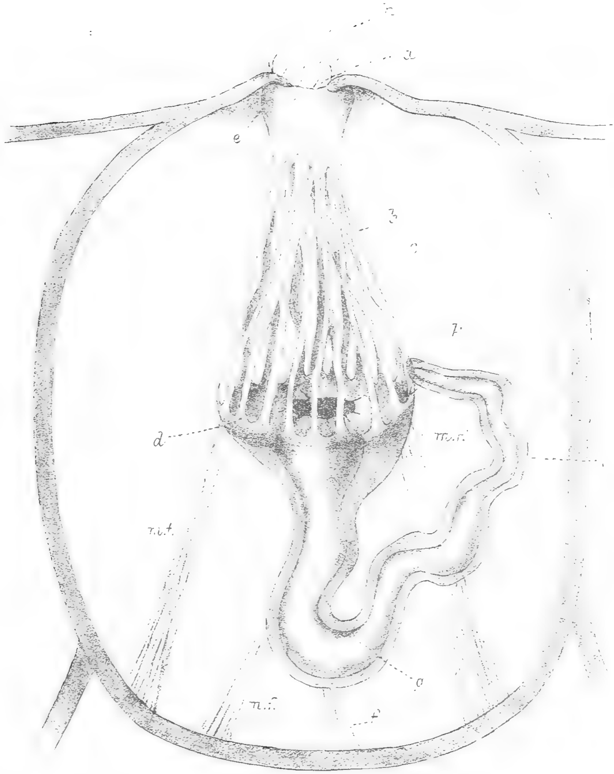
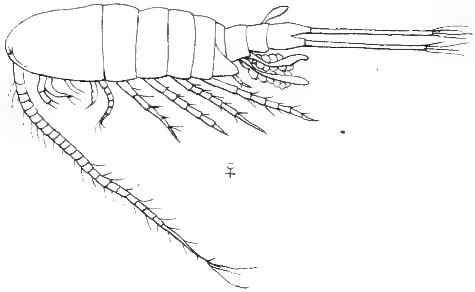


Fig. 3.

Parker & Coward, lith.

West, Newman & C° imp.

Alcyonidium gelatinosum.



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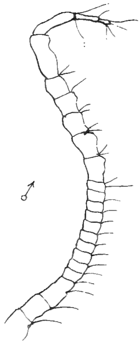

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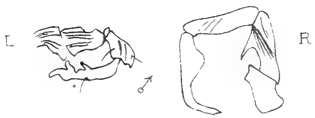

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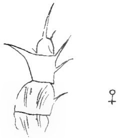
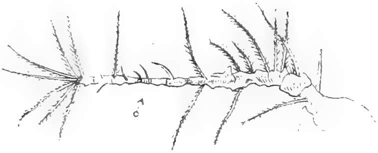


Fig. 4.

I. C. Thompson, del.
Parker & Coward, lith.
West, Newman & Co. imp.

Eurytemora hirundo (Giesbrecht)



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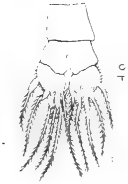

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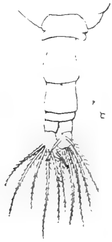


Fig. 3.

Fig. 4.

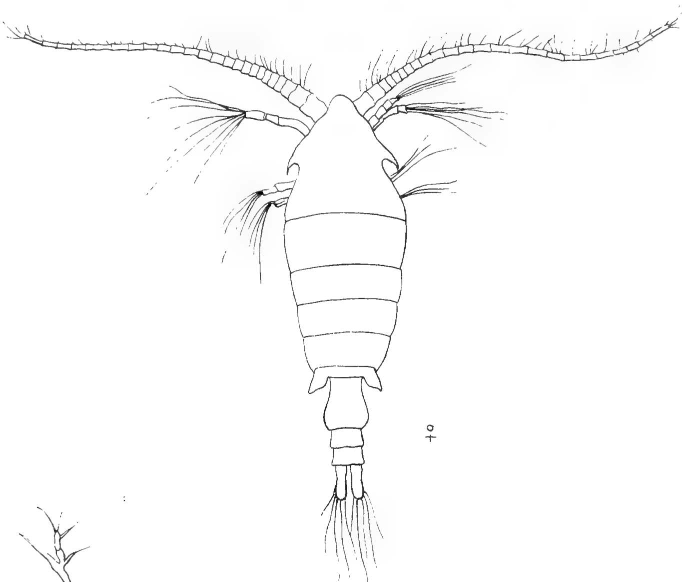
Fig. 5.

Fig. 6

I. C. Thompson, del.
Parker & Coward, lith.

West, Newman & Co imp.

Dias discaudatus (Giesbrecht)



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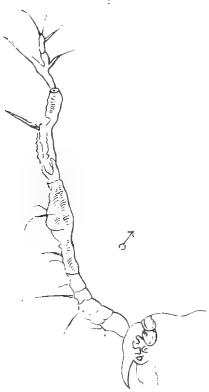

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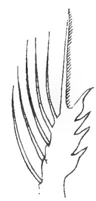

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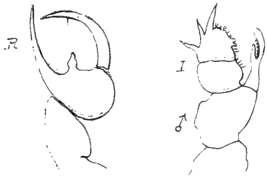


Fig. 4.

Fig. 5.

I. C. Thompson, del.
Parker & Coward, lith.

West, Newman & Co. imp.

Pontella wollastonii (Lubbock)

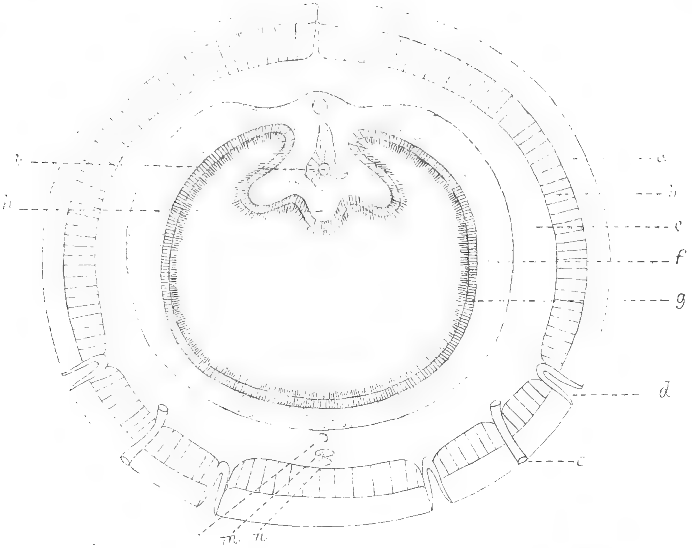


Fig. 1.

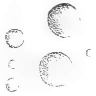


Fig. 6.

Fig. 2.

Fig. 3.

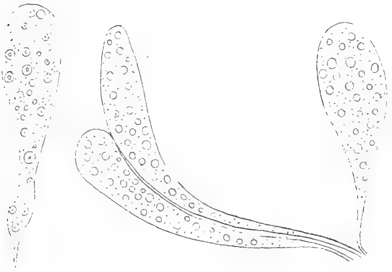


Fig. 4.

Fig. 5.

R. J. H. G. del.
Parker & Coward, lith.
West, Newman & Co. imp.

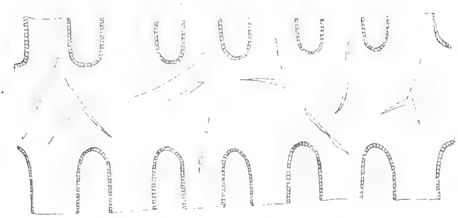
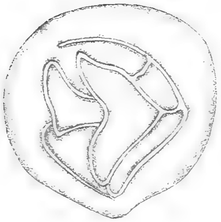


Fig. 1.

Fig. 2.

Fig. 3.



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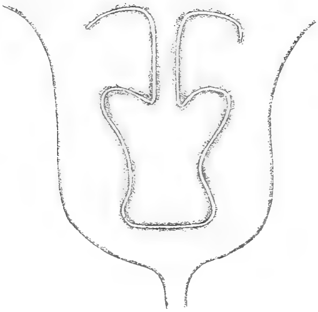

Fig. 5.

Parker & Coward, lith.

West, Newman & C°. imp.

Fig. 1. Boltenia pachydermatina.
Fig. 2. Boltenia gibbosa. Fig. 3. Polycarpa tinctor.
Fig. 4. Polycarpa, n. sp. Fig. 5 Polycarpa, n. sp.